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Reduction of Rates as a Fact, Not a Theory

WHILE the general public is constantly voicing its human desire for cheaper everything, including electricity—though in general electric service is already recognized as low-priced—and while politicians and so-called public benefactors are urging government ownership of utilities as a means to "cheap power," the electrical industry is constantly at work to bring about greater economies and actually lower prices to the consumer. On every hand there is evidence that the professional and business ability of electric utilities, working under the supervision of the public's own representatives on the commissions, is almost daily bringing about actual and not theoretical savings to the consumer's purse. The latest direct evidence along this line is the announcement by President McCarter of the Public Service Corporation of New Jersey that the electric company's rates will be reduced so that the public's annual bill will be $1,500,000 less than at present, based on the existing volume of business.

The best answer to any propaganda or argument is accomplishment, and the history of the electrical industry to date has been one of accomplishment in both the rendering of service and the constant reduction of its cost. The more fully these facts are told to the public itself the less will there be to fear from the misdirected efforts of the politicians to use public utilities as a stepping stone to office, with threatened political ownership and the increase in cost of electric service which would inevitably result from control by unqualified managers.

An Interesting Educational Development

THE news of the endowment of the new Moore School of Electrical Engineering at the University of Pennsylvania is of interest to all electrical engineers. For, in addition to the fact that this is the first school of electrical engineering as such to receive a bequest exceeding a million and a half dollars, none of which is to be expended on buildings, the legacy will also provide the opportunity for a great educational and research experiment.

The conferring of honorary degrees on four past-presidents of the American Institute of Electrical Engineers last week is an earnest of a policy which Dean Pender expects to follow in the future. This policy calls for close co-operation between the school and industry and for the stimulation of the faculty by offering them inducements to participate in research and engineering activities. By reducing the amount of time spent in the classroom and by offering reasonable hours and adequate salaries to members of the faculty, thereby encouraging them to do research and consulting work, Dean Pender hopes that teaching will become less irksome and more vitalized and will become more directly responsive to developments in the theoretical and practical phases of electrical engineering. Staff members will be encouraged to do consulting work, to make economic or engineering studies on operating systems or to do laboratory research work in the school. In the event that pure research is chosen, a bonus is to be added to the normal salary, its magnitude depending on rank and other special conditions.

Many questions of practice, ethics and education are involved in the proposed plan, but it is a constructive attempt to obtain better teachers and to produce better-educated students, and its development will be watched with eager interest by many engineers and educators.

Midwinter Convention of A. I. E. E. Sets New Mark of Accomplishment

THE midwinter convention of the American Institute of Electrical Engineers, held last week in Philadelphia, the first time it has left New York, excelled all its predecessors both in attendance and in generality of appeal and interest. The registration of 1,600 compared with the 1,150 of 1923 should be sufficient answer to those who debated the feasibility of ever holding the convention elsewhere than in New York. But most important is that the gathering aroused widespread commendation from all types of engineers in attendance. It was a convention which symbolized the profession and the art and illustrated the effective scientific, social and economic influence and progress of an organized body of professional engineers.

In several ways this convention was different from many held in the past. The midwinter meeting has come to be called the working convention because it usually records the results of the year's researches and is noted for the number and quality of technical papers presented. But while this convention added to the fame of past meetings in this respect, there were many other elements connected with it which make it a landmark.

There was not only a sense of technical accomplishment and progress, but there was also an all-pervading note of enthusiasm and optimism about the electrical art, associated with a humanity which received its impetus from the remarks of the pioneers at the fortieth anniversary celebration. The inspiring and human addresses of Sperry, Martin, Thomson, Carty, Insull, Ryan and Lieb, based on their own pioneer experiences and warmed by their great personalities, struck and maintained a note that was prevalent in all succeeding meetings. The engineers were more social in their habits and more expressive of their feelings than in the past, and to this warmth in their human relationships should be added many colorful evidences of their greater recognition of their duties as citizens and belief in ideals of service.

The meeting on transportation, at which the electrical

industry placed its communication resources at the disposal of a sister industry from altruistic motives, set a milestone toward the realization of a closer co-operation with and better understanding of the electrical industry by the other great industries of the nation. And attendance at the dedication of the Moore School added a touch of education to the broad communion of minds which existed. Social events and entertainments were well attended and served admirably to cement the warm personal relationships existing in the fraternity. Measured by any standard, the meeting was abundantly worth while, and the quality, enthusiasm and optimism of the engineers augur well for the future of all phases of the great electrical industry whose successful progress means so much to mankind.

Reduced Lamp Prices Another Step in Lowering Electric Service Costs

ONE of the greatest accomplishments of the electrical industry is that, coupled with the steady expansion both in methods and extent of the service it renders, it has been able constantly to reduce the unit cost of that service. Central-station companies, from the very establishment of the business, have consistently worked to keep the cost of electrical energy low, and their rate reductions, even in spite of the higher costs of the war and post-war period, have been noteworthy and numerous. Another large element in the cost of electric service is the price which must be paid for the translating device on the consumer's premises, and it is also a great credit to the industry that the electrical manufacturer has been able to keep his prices from being carried upward by the constant climb of the cost of materials and labor. One of the most significant of recent announcements in this line is that of a further reduction in the price of incandescent lamps, so that the present average is 30 per cent below the pre-war level.

Above all other devices, the most generally known, the almost universal symbol of electric service itself, is the incandescent lamp. It still accounts for about 80 per cent of residential revenue and is the largest single factor in the business and industrial use of electricity. And the phenomenal fact is that the cost of a given amount of "illumination" (lumen-hours) by incandescent lamp is today only about one-ninth of what it was some thirty years ago—at a time which was no longer the pioneer stage but when the incandescent lamp was already in widespread use. This was ably pointed out last June before the A. I. E. E. by Messrs. Howell and Schroeder, who gave many other important facts with reference to the development of lamp quality. The fact is generally recognized that this lower cost has resulted from the combination of reduction of the cost of energy, reduction in the cost of lamps and increase in the efficiency and life of the lamps. As a matter of fact, the history of the incandescent lamp is the very embodiment of close co-operation between the central-station companies and the manufacturers—constantly working for greater efficiency, uniform quality and lower cost of illumination to the customer.

The latest price reduction in lamps—the fourth in two years—is another noteworthy step and deserves special attention on account of its principal cause—reduction in costs due to the new equipment which has recently revolutionized lamp manufacture and placed it on an entirely different plane as to quantity production.

The Lamp Has Set a Challenge

THERE is an aspect to this reduction in the price of lamps other than the resulting lower cost to the consumer. This aspect is what the reduction signifies as a manufacturing accomplishment—it acts as a challenge in the manufacture of other electrical products. What Henry Ford has demonstrated to the automobile industry the larger incandescent lamp factories have demonstrated no less conclusively to the electrical industry. Both cases involve the fundamental economic principle that improved machinery and processes, under favorable conditions made possible by mass production, may offset the great increase which has come in the cost of both labor and materials and reduce the cost of the product to the consuming public. Such an operation it is that has brought the automobile into the almost universal service of the masses. It has caused this reduction of the price of lamps to an average 30 per cent below the pre-war level, in spite of the fact that the cost of labor in the lamp factories has doubled and the cost of materials more than doubled in the period. Improved lamp-making machinery has so cut the labor cost per unit and economized on factory space as actually to result in a marked saving to the consumer. Meanwhile, there are two and a half times as many incandescent lamps in use as there were ten years ago. How much of this increased consumption has been induced by falling prices, of course, can only be conjectured.

It is a notable achievement in industrial history that is worth the serious consideration of every other manufacturer in the electrical industry. How far can this same principle of improved processes and greater production be invoked to reduce the cost of other electrical commodities and influence the expansion of the market—which means the increased consumption of electrical energy and the greater use of electrical appliances and accessories, to the benefit of our entire industry and all the people? It will be but natural for other manufacturers to say, "But lamps are different." Yet automobiles are unlike lamps. After all, it is not a matter of the nature of the product, but rather the potential capacity of the public to desire and assimilate. Few men could see the greatness of the demand for motor cars when Ford began to make his dream come true. And when the vastness of the market that lies ahead of the electrical industry is considered, no one can doubt that other great industrial pioneers will in other directions find the way in a manner no less spectacular in this field of unparalleled opportunity. Lamps have set a challenge to electrical men.

"Handling the Public"

WHAT does a central-station man mean when he says or writes of "handling the public"? It is a phrase, yes—just a matter of speech—but it seems to indicate a habit of thinking that is out of tune with the very fundamentals of public service. It is another symptom of that dire malady that attacks government and public utility employees and manifests itself in so many ways. It causes the street-car conductor apparently to think that he is herding cattle. It makes the collector of the telephone company forget that subscribers are customers. It affects the girl at the window in the gas office so that she loses her good manners and

hurts the feelings of many friends. It so warps the minds of central-station meter readers that they fail to appreciate that they enter these homes of strangers not as masters but as servants. It upsets the perspective of many executives so that they fail to remember that "consumers" are, after all, individuals and citizens with rights and sensibilities equal to their own.

When a stranger calls, or when a friend drops in to speak to any man or woman in home or office, there is never any question as to the way in which the visitor should be received. He is not "handled." He is sure of a greeting and consideration. Why is it, therefore, that when the single stranger becomes one of many, an individual unit in a class relationship, he must lose caste and be called upon to sacrifice so much? Why must he be "handled"?

There is no reason for it—no excuse but that of thoughtlessness. But this thoughtlessness must not be condoned and then become an organization practice and a policy. "Handling the public" is a costly proceeding—and dangerous—and it is well for the fact to be openly considered and frankly discussed from time to time in every central-station organization.

The Practical Railroad Viewpoint

ONE of the departures from previous practice at A. I. E. E. conventions which appealed very strongly in Philadelphia last week was the manner of presenting the railroad problems. Two sessions devoted to this question were full of discussion from the railroad man's point of view. The technical session on Tuesday afternoon was a refreshing divergence from the past practice of discussing steam railroads from the point of view of the details of electrification. Instead, if on their face remote from electrical engineering, yet intimately related in some respects, the discussions gave an accurate outside viewpoint that would bring to any technical body a new perspective of its relation to the rest of industry and its opportunity to be of greatest service. The success of the transportation session was largely due to the chairman's sincere request to the railroad representatives to point out their problems and requirements so that electrical engineers might co-operate in solving them and his very successful effort to avoid letting the meeting run into a discussion of steam versus electric locomotives. In the remarks which were made every executive and engineer interested in seeing more extensive electrification of railroads will find valuable guidance. The factors which will determine electrification possibilities and programs are not so much electrical ones—they are primarily railroading methods and limitations. The electrical industry will provide the service as required by the railroads. A better understanding of the controlling factors of the railroads will help the electrical industry to co-operate to the highest degree—and it was a discussion of such factors that took place at Philadelphia.

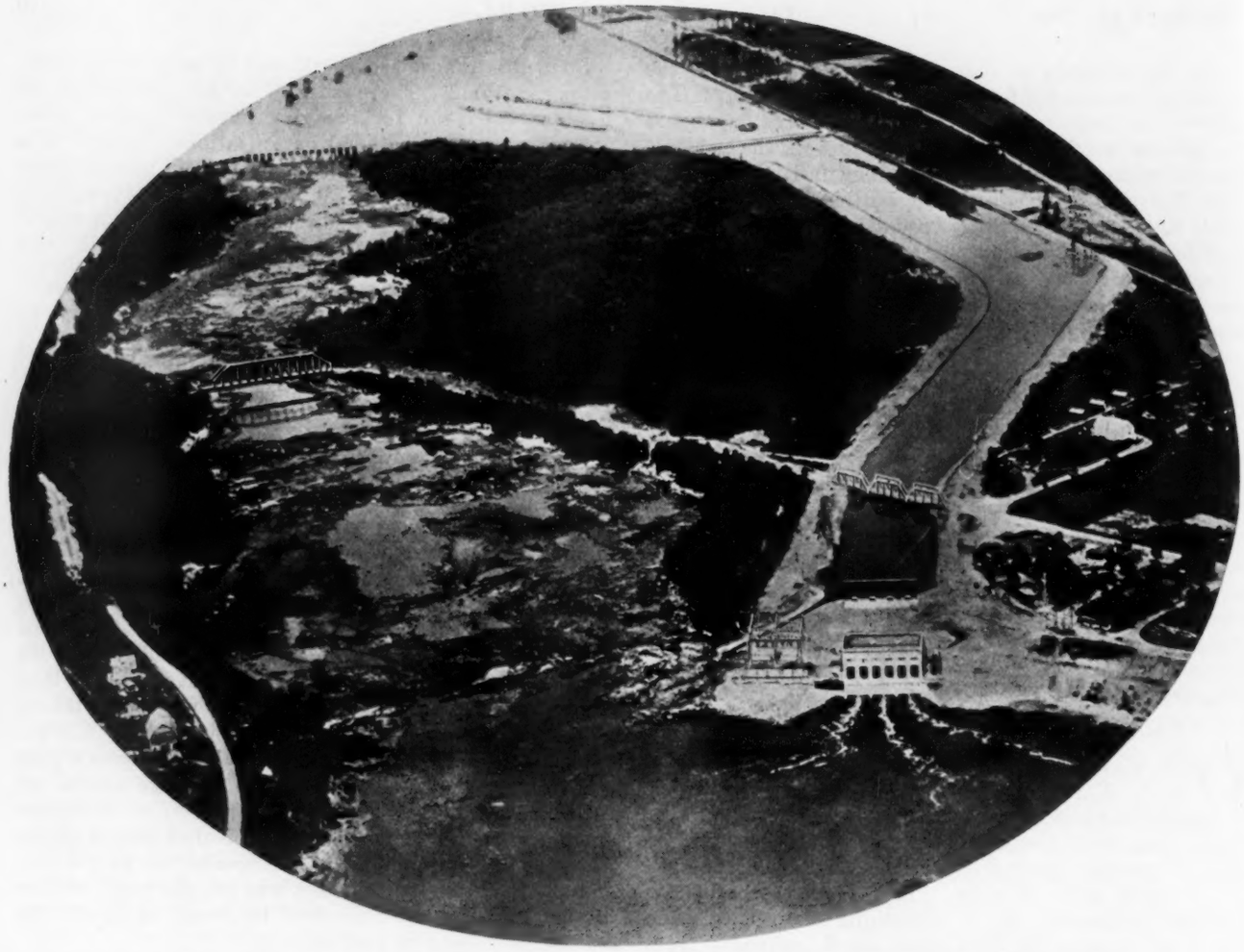
The session devoted to the financial problems of railroads applied so closely to every other public utility, including the electrical, that the session was not only constructive in giving a deeper insight into an industry essential to national prosperity, but it touched on a common bond of sympathy. Fortunate indeed it was that the message of Messrs. Budd, Sisson, Thayer, Buckland and County could be broadcasted widely.

Shall this innovation be allowed to pass merely with commendation? There should be an opportunity at least once a year for bringing similar outside viewpoints before our national organizations. Where it is done, however, care must be taken to avoid general presentations, such as would appeal to any public audience, and instead to make the discussions serve as a means of showing the particular organization how it can co-operate.

Theoretical and Practical Aspects of Superpower Discussed

SUPERPOWER discussion came to a temporary focus this week in the opening session of the midwinter convention of the American Institute of Electrical Engineers, when six papers on the technical phases of 220-kv. transmission were presented. The meeting was noteworthy as indicating the considerable number of engineers who are devoting their best efforts to the study of the problem and the high character of those efforts. Nevertheless, it cannot be said that as a result of this meeting the realization of the dream of general superpower supply is materially advanced. In fact, there was a distinct discouragement in finding that almost without exception the papers were directed to pointing out the limitations of long-distance 220-kv. transmission, either in the amount of power which may be delivered or in the difficulties of voltage control or in the general conditions of operation. The maximum amount of power which may be delivered over a single 500-mile line was placed by one speaker at 70,000 kw. and another asserted that this was not the most serious matter, as a method must first be found to handle the transients arising in load changes.

Perhaps the most notable feature of these papers was the apparent unwillingness of the authors to consider more than one intermediate synchronous-converter substation in a 500-mile transmission. Does this mean that our transmission engineers are so rooted in the traditional methods pertaining to unbroken lines of moderate length that they do not realize that a superpower system is a problem of quite different nature, and that in attacking it the courage of a free imagination must be freely exercised? Every one knows that a perfectly compensated line would be free from most of the limitations and difficulties discussed at the meeting. Moreover, it is fairly obvious from the papers presented that only a short step in the direction of such compensation is necessary, and that the introduction of only one or two more substations would substantially increase the capacities and reduce the operating troubles of such lines. Substations are costly, and they may reduce the attraction of particular transmission projects, but why not recognize that they are probably the unique and sufficient remedy for the bugbears of long unbroken lines and consider the problem from the standpoint of the minimum number necessary for the exchange of adequate amounts of power under satisfactory operating conditions? The encouraging note of the meeting was the remarks by the chairman, F. G. Baum, reporting the successful enlargements of high-voltage interconnection on the Pacific Coast. It was stated that the results of experience in this direction all indicate greater and greater stability of operation with the increase in the number of branch lines connected. This is a result to be expected when the matter is looked at in its broadest aspect.



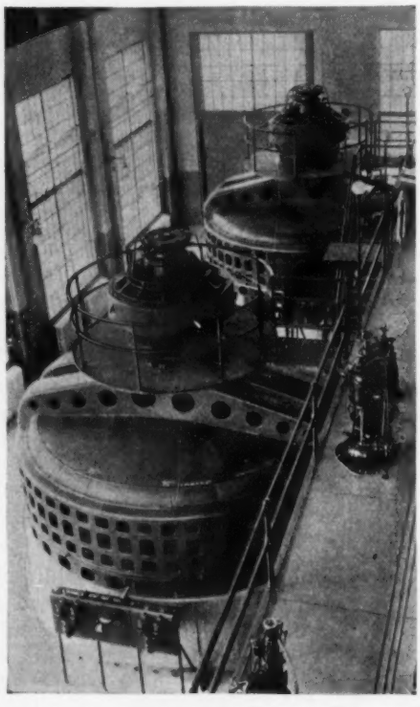
A New and Interesting Hydro-Electric Development

THE Jim Falls development of the Chippewa Power Company, which was put into operation April 15, 1923, is interesting because of the penstock construction adopted to avoid collapsing, the provision of the sluice to relieve surges when the load is thrown off the units, the employment of steel instead of cast-iron guide vanes in the waterwheels, the location of the governor actuators on the switchboard platform, the direct attachment of the exciter armature to the generator rotor, and the method of pouring the concrete, which, according to reports, saved 40 per cent over previous constructions.

A head of 30 ft. is obtained at the dam, and an additional head of 22 ft. is obtained by running a canal approximately 3,000 ft. long to a point above the power house where penstocks convey the water to the wheels. At the lower end of the canal, adjacent to the power house, is the sluiceway which relieves the surges when the load is thrown off the units. When this occurs the surge of water may amount to as much as 3 ft. or 4 ft. increase in water elevation.

Because of the large penstocks employed (14 ft. in diameter) it was considered absolutely essential to provide a design which would not collapse owing to a vacuum or to the pressure of earth on top of it. Consequently the penstocks were made of $\frac{3}{8}$-in. steel plate with stiffening angles placed every 5 ft. along the penstock. Breather pipes could not be relied upon entirely, because they are liable to freeze shut under the extreme temperatures experienced—30 deg. to 40 deg. below zero.

The turbines are of the single-runner vertical-shaft type inclosed in a steel spiral casing. Steel guide vanes of a cast-steel type are employed and proved their merit on the second day of their operation. When the plant was first started there was no boom provided to prevent logs and construction material from drifting into the penstocks, and consequently two or three heavy blocks of wood were carried into the guide vanes, tearing off a portion of one and bending two others. These were repaired in five to six hours by heating the vanes, bending back the plate and welding a patch on the broken vane.



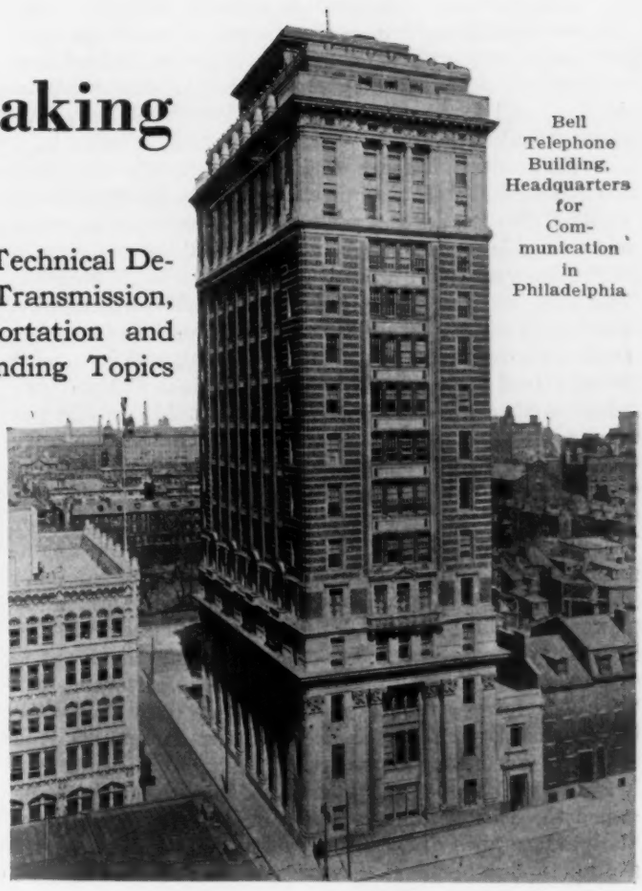
The actuator part of the governor equipment was mounted on the switchboard platform, which is at the same elevation as the platform around the direct-connected exciters.

The floor of the draft-tube pit was poured as one mass. The draft tubes were made of steel plate. These and the hydraucone regainer sections were mounted on the draft-tube pit floor. Then the contractor built up forms and poured the side walls around the hydraucones, the deck over the draft-tube pit and the side walls inclosing the plate-steel spiral casings.

In addition, only a skeleton type of power house was employed, the generator and turbine floors being combined and thus providing for what is commonly called a single-floor power station. The generator is mounted on a concrete column carried up above the steel-plate spiral casings.

High Lights of A. I. E. E. Record-Breaking Convention

More than 1,600 Engineers Discuss Technical Developments in the Electrical Art—Transmission, Communication, Metering, Transportation and Equipment Advances Were Outstanding Topics



Bell Telephone Building, Headquarters for Communication in Philadelphia

ENGINEERS are becoming accustomed to record-breaking accomplishments, so the fact that the largest attendance ever recorded at an Institute convention occurred in Philadelphia during the week of February 4 is in itself not startling, however encouraging. But real food for thought is afforded because this large number attended a convention which presented more than forty highly specialized papers on ultra technical aspects of the electrical art. This is indicative that theory and practice are closely allied and that all engaged in electrical engineering await eagerly the annual contributions of the research specialists whose work has been foundational to all commercial developments.

The text of the convention might well have been taken as the intelligent use of electrical power for human needs, for to the material advances recorded in communication, transmission utilization, theory and measurements which brought the day nearer for the wholesale use of electrical energy to replace labor was added a very definite element of education and culture. The specialist authors made great and successful efforts to interpret their papers in terms understandable by the audiences and the ideal of service formed a background for all sessions. Special feature programs, such as the celebration of the fortieth anniversary of the Institute, the Edison medal presentation to John W. Lieb, the dedication of the Moore School of Electrical Engineering and the transportation meetings, developed renewed interest in historic, patriotic and cultural elements in engineering activities.

The American Institute of Electrical Engineers and the local convention committee are to be congratulated on the program and general convention arrangements and the following brief report of the meeting is but an interpretative outline of its technical aspects. Space prohibits any attempt adequately to report the details of the papers and features of this large and unusually successful convention of the Institute.

Transmission Stability and Limits

The transmission of large blocks of power over long distances was the subject of six very able papers presented Monday afternoon by F. C. Hanker; Percy H. Thomas; R. D. Evans and H. K. Sels; R. D. Evans and R. C. Bergvall; E. B. Shand, and C. L. Fortescue, and C. F. Wagner respectively. Each of the authors assumed 220 kv. as the voltage for the bulk transmission of power over a distance of 500 miles, and discussed the electrical characteristics and methods of operation involved. Mr. Thomas proposed a four-circuit 400,000-kw. transmission system delivering power at four different points into an interconnected network with synchronous condensers at the load ends of the lines. High-tension switching of live lines was not included. With this layout he endeavored to point out that instability of operation was a very remote possibility. In his opinion, after studying the particular case selected, it would be inadvisable from an economic and operating standpoint to use an intermediate synchronous condenser station. Another novel feature was the absence of high-tension switching and the fixed connection of generating and load ends of the lines.

In the other five papers which were presented by Westinghouse specialists, an attempt was made to determine the power limits set by operating stability, making use of the power circle diagram. The conclusion of these papers was that introduction of synchronous condensers at a mid-point in the lines would give them practically the same stability as a 250-mile line. The papers dealt with the limiting conditions and did not attempt to discuss the economic considerations of the problem.

All Elements Must Be Considered

A very active discussion of the papers ensued in which a number of engineers, notably E. L. Moreland, Ralph E. Booth, V. Bush and R. E. Doherty, pointed out that the power limits determined in the papers would be reduced by considering the effects of transients and inertia in rotating equipment and regulating devices. Mr. Doherty referred particularly to some calculations in which power limits were reduced 37 to 40 per cent below those given in the papers by considering synchronous reactance. Frank G. Baum interposed some practical experience, saying that the stability of Western long-distance transmission systems had been increased

by adding lines. Several engineers excluded high-tension switching from the assumptions on which their conclusions were based, but A. E. Silver contended that such switching is absolutely essential, especially at the receiver end to take advantage of diversity factor, division of load and to utilize equipment most effectively.

Some economic phases of 500-mile transmission were touched on by H. R. Summerhayes, T. A. Worcester and F. W. Peek, Jr., each of whom pointed out the necessity of being able to transmit at least 100,000 kw. per circuit, if the lines are to be justified financially. Mr. Worcester, who said that the stable load limit of a 500-mile 220-kv. line is between 80,000 and 100,000 kw., questioned whether such lines could be justified. To bring out his point he said that such lines would cost at least $29 per kw., which with a generating cost as low as $15 to $20 per hp.-yr. and transformer losses would make the delivery cost at least $48 to $54 per hp.-yr. If the load could be carried consistently 7,200 hours out of the year, the delivered energy cost would be 6.6 to 7.5 mills per kw.-hr., which price could hardly compete with steam-generated power, he contended. Divided conductors such as Percy Thomas has suggested would increase the power limit 50 per cent, he declared, and reducing the frequency to 25 cycles would make a 500-mile line the equivalent of a 208-mile 60-cycle line. However, even with the lower frequency the delivery cost would be 6 to 7 mills per kw.-hr., allowing for investment and losses in frequency changers.

Prof. V. Karapetoff referred to a mechanical device called the Heavysidian, which can be utilized to study the performance of any line, of any length, and at any voltage. Another device is being made which will take transients, inertia of rotating equipment, etc., into consideration.

In closing, at least two authors, Messrs. Fortescue and Bergvall, expressed the belief that there is entirely too much pessimism regarding the seriousness of transients produced by sudden load increases.

Theoretical Aspects of Dielectric Losses

GASEOUS ionization in built-up insulation by Dr. J. B. Whitehead and the magnetic properties of silicon-carbon-iron alloys by T. D. Yensen were the two subjects which drew forth the most discussion at the Tuesday morning session, although three other subjects were treated in papers—namely, free connection of heat in gases and liquids by C. W. Rice, overdamped condenser oscillations by Dr. C. P. Steinmetz (deceased), and alkali-vapor detector tubes by H. A. Brown and C. T. Knipp. The paper by Dr. Whitehead constitutes the second instalment on this subject and applies to built-up insulations consisting of paper or cloth binders and varying proportions of mica. He found that pressure of the samples increased the dielectric loss below the ionization point, but reduced it above this point. Mr. Yensen pointed out that it is now possible to determine the magnetic properties of materials fairly accurately from chemical analyses and photomicrographs of grain structure. Amorphous inter-crystalline material is deleterious to magnetic properties, but is reduced by alloying silicon with the iron. Silicon graphitizes any carbon content and reduces hysteresis. The paper by Dr. Steinmetz harmonized the discharge phenomena through leaky condensers with existing theory. In Mr. Rice's paper general expressions were developed by means of dimensional formulas for calculating the convection from any system of similar bodies after three constants have been experimentally determined. The paper on alkali-vapor tubes referred to the performance of these tubes.

In the discussion regarding ionization of built-up insulations the question was raised as to how destructive ionization is to insulations and whether the relation of power factor to impressed voltage would not constitute a better basis for comparing dielectric losses and for indicating when ionization becomes serious. Several people pointed out that the destruction wrought by ionization is caused by ionic bombardment and nitrous acid or ozone, crystalline mica being practically immune but fibrous material being very vulnerable. Dr. Whitehead declared that ionization, even when small, will cause deterioration of fibrous materials in a few hours, due to the formation of ozone.

At least three engineers, namely, E. S. Lee, Alex Nyman and Herman Halpern, agreed with F. M. Farmer that power factor plotted against impressed voltage is a good method of comparing dielectric losses, although Mr. Halpern pointed out that the relation of power factor to maximum dielectric stress would be a more significant factor. However, Dr. Whitehead contended that in his experiments the power factor curve did not indicate when ionization began. He urged against placing too much reliance on the relation between power factor and impressed voltage. Alex Nyman pointed out that in condensers with dielectric stresses of several hundred volts per mil it is very essential to apply pressure to reduce ionization, but in addition the voids must be filled by some impregnating process.

T. Spooner, in discussing the magnetic properties of silicon-carbon-iron alloys, declared that one operating company had placed a value of $800 per kw. on reduced core losses in distribution transformers, and $300 to $400 per kw. for power units. Hence if the core loss could be reduced 20 per cent by the use of silicon-carbon-iron alloys or others with still better characteristics the purchaser could afford to pay 8 to 20 cents per pound more for the core material. Mr. Yensen expressed the belief that rolled-sheet silicon-carbon-iron alloy would have as good characteristics as those presented in his paper, but pointed out that precautions would probably have to be taken with thin sheets to avoid effects of excessive oxidation. Sheets can be made with a loss of less than 1 watt per kilogram at 60 cycles and the flux densities required in transformers operating at this frequency.

Steam Railroad Problems Discussed

A VERY interesting meeting was held on Tuesday afternoon at which some railroad transportation problems, which electric locomotives will have to solve if they are to be adopted more extensively, were discussed from the railroad viewpoint. Unfortunately, several railroad representatives who had been invited to participate did not attend. Among those who did take part in the discussion were L. G. Coleman, assistant general manager Boston & Maine Railroad; J. E. Crawford, assistant general manager Norfolk & Western Railroad; M. Ballentine, Seaboard Air Line; A. H. Babcock, Southern Pacific Railroad, and William E. Elmer, Pennsylvania Railroad.

Mr. Coleman pointed out that present steam locomotives can handle much longer trains than formerly but they also cost considerably more, are available for service only about 45 per cent of the time, and the maintenance per ton-mile is almost double that in 1900. If the

steam locomotive is to hold its place it must justify the investment. Hence the door is wide open to electrification, and engineers are to blame if it is not adopted more generally. The speaker declared that among some of the conditions which the electrical industry will have to consider are the strength of rails, the capacity of passing tracks, and the fact that most bridges are limited to axle loads of 60,000 lb. The electric locomotive must be adapted to do what the steam locomotive does. If electric freight locomotives can be made to haul a train at 50 m.p.h., it is possible that the increased capacity would make it more attractive, the speaker declared. The fact that the cost of locomotives constitutes only about 50 per cent of the total investment for electrification makes it too expensive an undertaking for most railroads at present.

Results on Norfolk & Western

The Norfolk & Western Railroad is handling 900 cars a day over a 2 per cent grade with electric locomotives at 8 per cent less cost than with steam locomotives, Mr. Crawford declared. Their starting pull is no greater than that of Mikado steam locomotives, he contends, but they will start a train in two minutes and attain a speed of 14 m.p.h. in four minutes, whereas steam locomotives may take ten minutes for the starting operation and then attain only 8 m.p.h. To justify itself the electric locomotive should make twice the mileage that a steam locomotive does, the speaker declared. He admitted that the electric locomotives have handled more ton-miles per year than modern steam locomotives, that electrics are available 85 per cent of the time compared with 50 per cent with steam, that they maintain higher speeds on grades, are more flexible in operation and less destructive on equipment. Besides, repairs are about 37 per cent greater on steam locomotives than on electrics, and the fuel saving of electrics is about 25 to 30 per cent over steam. Regenerative braking has also been a great saving, since the electric locomotives can handle heavy trains on down grades without applying air brakes. No unusual amount of trouble is experienced with the electric contact system being torn down by wrecks, and delays are no greater than with steam locomotives. However, the speaker pointed out that the electric locomotives cost twice as much as steam pound for pound, which is a measure of their tractive effort. Mr. Crawford announced that his company will continue to electrify as steam equipment is scrapped. Twenty additional miles of electrification are to be made shortly and eventually an entire division will be electrified.

Mr. Ballentine called attention to the failure of the electrical industries to correlate the merits of the various systems of electrification before approaching railroads with proposals to electrify. The difference in cost between electric and steam locomotives is not what interests railroads, he declared, but the total costs of operating a road with either system. "What can you get out of an electric locomotive during peak loads?" the speaker asked.

A. H. Babcock maintained that the over-all economy of trunk-line electrification had not been proved by demonstration and demanded such proof before he could be convinced of its justification, except in terminals. He declared that he is running oil-fired steam locomotives from El Paso to Los Angeles and back—a distance of 815 miles—without running them into a roundhouse during the round trip.

In reply to Mr. Babcock's demand for proof W. S. Murray said that since terminal electrification is excluded from evidence in favor of trunk-line electrification, and since Mr. Babcock maintained that all railroads do not have such ideal conditions for operating electrics as does the Norfolk & Western Railroad, it is impossible to submit practical evidence of the economy of electrification, since the two roads which do operate electrified trunk lines are not operating under favorable conditions. He questioned why railroads are apparently averse to buying power from electric-service companies, saying that if they did they would not invest money in generating plants, and equipment bonds would be accepted by banks for financing electrifications, thus allowing railroads to devote their entire capital to transportation.

Some specific information was presented by Mr. Elmer to indicate what conditions electrified equipment will have to meet to become adopted extensively. For example, freight-car couplers and draftgear are limited to 400,000 lb. drawbar pull. A train 4,500 ft. long is about the maximum that can be handled conveniently regardless of power available. Fifty miles an hour is hardly a practical speed for freight trains with present car loads (208,000 lb. total maximum) due to the possibility of hot boxes. Mr. Elmer expressed the belief that 20 m.p.h. would be an economical average speed for freight trains on 100-mile divisions as it would allow three hours for putting trains into and out of service, and leave five hours for actual running time, or a total of eight hours a day for train crews.

Late Developments in Electric Elevators

A VARIETY of papers were presented at one of the technical sessions on Wednesday morning, and a great deal of discussion followed, particularly on two papers presented on late developments in elevators. David Lindquist and E. W. Yearsley discussed the factors entering into the predetermination of elevator performance and by means of combined mathematical and graphical methods applied fundamental laws to the problem and obtained results of great value to designers of elevator equipments.

A second paper, by E. M. Bouton, described the latest developments in variable-voltage control systems for elevators and showed how uniform acceleration and deceleration were obtained, as well as how the torque on upward and downward movements was maintained practically of the same value. In the system described each elevator motor was supplied by an individual generator driven by a motor operating from the alternating-current or direct-current supply. The generator's voltage, and hence the elevator motor's speed, is controlled by varying the field of the generator. A direct-connected exciter is used for the field, brake and control circuits.

The installation can be used for any commercial alternating-current voltage and frequency, and high speeds are obtained, together with extreme accuracy and smoothness in operation. Animated discussion of the relative advantages of rheostatic and variable-voltage control systems for elevators ensued, and one or two alternative control arrangements were suggested. Some argued that the jumps and unequal torques of the rheostatic control system could be reduced and that the complexity and cost of variable-voltage systems were disadvantages.

A new type of alternating-current voltmeter was discussed in a paper by L. T. Wilson. The new instru-

ment is made by the Weston company as a portable meter in ranges from 1 volt to 20 volts with an accuracy of 1 per cent for any frequency up to a million cycles. It utilizes the thermo-voltmeter principle and uses only 2 milliamperes at full-scale deflection. By means of special shields and novel circuit arrangements the author has very greatly improved the commonly used instruments of the thermal type. In the discussion that followed a vacuum-tube meter was suggested as simpler and cheaper, but it has the disadvantage of requiring calibration on variable wave-form circuits.

An oscillographic study of the permeameter formed the subject of a paper by W. B. Kouwenhoven and T. L. Berry, Jr. The authors showed that the use of a laminated core and the elimination of all chances for induced currents greatly increased the speed of magnetic testing with the instrument. The remaining paper at the session was by A. L. Penniman, Jr., and discussed power-station auxiliaries and their relation to heat balance. The author advocated stage bleeding and electric drive using both alternating-current and direct-current supplies. He groups the auxiliaries into classes and utilizes bus power for all but those considered essential or best used with direct current. For these he suggests the use of a direct-connected direct-current auxiliary supply generator on the shaft of the main unit.

SHAFT CURRENTS IN MACHINES

Causes and prevention of shaft currents in electric machines, and methods of calculating eddy-current losses in conductors, tooth-pulsation and surface iron losses were subjects considered at one of the parallel sessions on Wednesday morning. In the paper on shaft current the authors, P. L. Alger and H. W. Samson, concluded that they are caused chiefly by dissymmetry in the magnetic circuits and can be remedied most effectively by using offset segmental punchings or punching holes in the low-reluctance regions. However, insulation which may have been inserted to prevent circulation of shaft currents should not be removed. James Burke, who had manufactured machines with offset segments for years, declared he had never had trouble with shaft currents. R. E. Gilman in a paper on eddy-current losses illustrated how simple it is to estimate accurately the effect of so complicated a phenomenon as eddy-current loss in stranded conductors. The dimensional formulas which Mr. Gilman used in his calculation give correct results only if there is only one conductor in a slot, Mr. Villardo declared in a written discussion.

An experimental method of checking the magnitude of flux pulsations in teeth of rotating machines which agrees very closely with calculations made by two methods was discussed by T. Spooner. Tooth losses, G. E. Luke emphasized, limit the output of machines because the teeth are subjected to the highest flux density and also because they are in such close proximity to the source of the copper losses. P. L. Alger pointed out that pulsation losses vary as the 1.5 power of resistivity and as the 1.7 power of lamination thickness according to dimensional formulas. The losses also increase as the square of the flux density until saturation occurs, when they increase more rapidly, Mr. Spooner declared.

In another paper, which Mr. Spooner presented jointly with I. F. Kinnard, it was concluded that surface iron losses can be determined with more precision by calculation than by test.

Static Condenser Design Arouses Interest

"Recent Advances in the Manufacture and Testing of Static Transformers," by R. E. Marbury; "Effect of Time and Frequency on Insulation Tests of Transformers," by V. M. Montsinger and Fred J. Vogel, and a physical interpretation of "Short Circuits in Alternating-Current Generators," by C. M. Laffoon, were the subjects of four papers on Thursday morning.

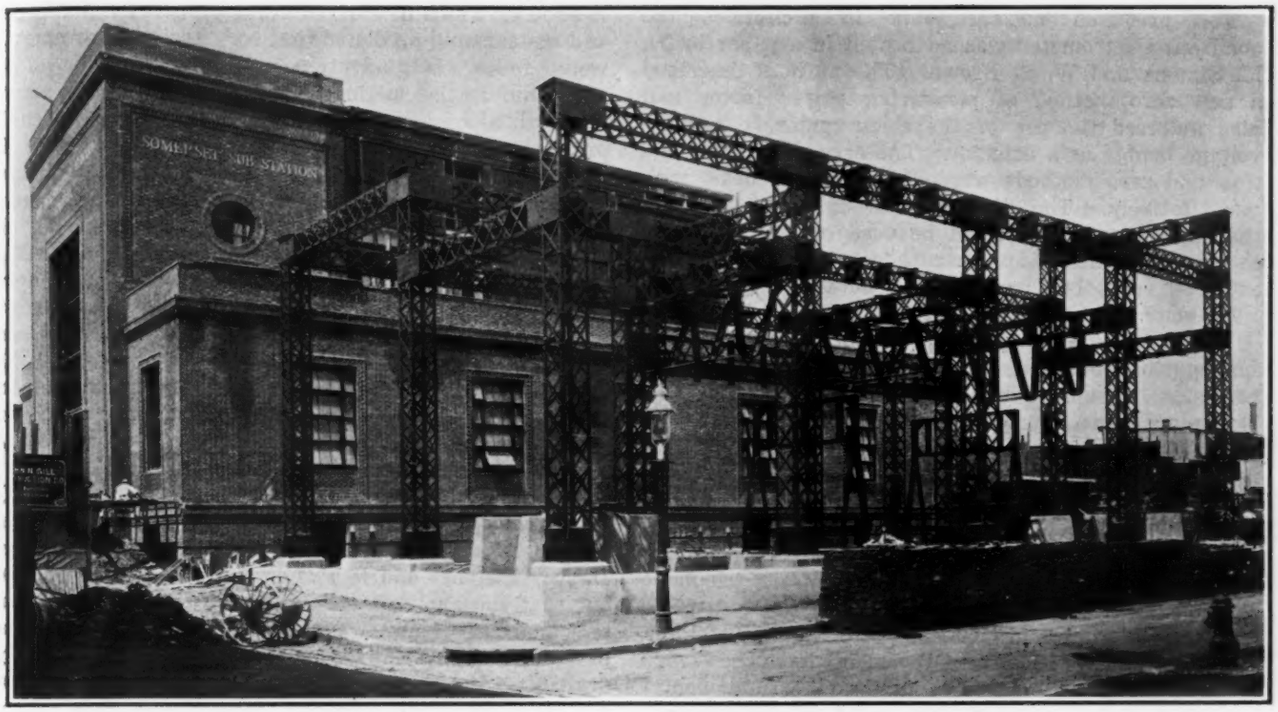
Mr. Marbury in his paper considered means of assuring reliability of static condensers and minimizing the price, pointing out that these requirements are being met by keeping the ratio between working stress and disruptive stress large and by accurate checking of insulation quality. This subject drew forth the greater part of the discussion at this session, considerable attention being devoted to the economy of using several sheets of thoroughly impregnated paper for insulation instead of a few thicker sheets, the possibility of working the insulation at higher dielectric stresses than cables and the effect of voltage harmonics on the corrective effect of static condensers.

E. K. Shelton brought out the fact that five sheets of ½-mil paper has one-fifteenth the porosity of one sheet of 2½-mil paper because the holes do not line up. Even with a dielectric stress of 350 volts per mil, a safety factor of six can be secured with 1½-mil paper, the speaker declared. Extraction of moisture from the paper under a vacuum and temperature of 125 deg. C. and impregnation with oil in spray form under the same conditions have been found very beneficial, Dr. J. E. Shrader asserted, while E. S. Lee pointed out that the barriers to oil circulation interposed by several thin sheets of paper make it possible to use very high dielectric stresses. Dielectric losses as low as two-tenths of 1 per cent are obtainable. Mr. Lee expressed the belief that if better insulations can be secured through refinements in manufacture it would be advisable to use them rather than to adapt condensers to insulations already available.

A very interesting fact was brought out by J. D. Stacey, namely, that, if voltage harmonics exist, the use of static condensers may be more detrimental than beneficial. To prove this he presented the results of some tests which showed great exaggeration of current harmonics when this condition exists and when the reactance in series with the condensers is less than 5 per cent. For example, in one case on a commercial power circuit the current harmonics due to using condensers with 3.5 per cent series reactance were 214 per cent of the fundamental and the power factor was reduced to 59.8 per cent, whereas increasing the reactance to 20 per cent reduced the harmonics to practically the same magnitude as the fundamental and improved the power factor considerably.

In closing the discussion Mr. Marbury compared the economic value of various grades of paper for insulation and said that, all facts considered, paper at 7 cents a pound is more valuable for 2,300-volt condensers than higher-priced paper with correspondingly better characteristics. He also pointed out that if the amount of series reactance used with condensers is not varied with the amount of capacity in circuit, resonance may be caused and the beneficial effects of reactance lost.

The observations and conclusions contained in the two papers presented by investigators from separate companies on the effect of time and frequency on insulation tests were remarkably consistent. Both authors



SOMERSET SUBSTATION OF THE PHILADELPHIA ELECTRIC COMPANY

found that the breakdown voltage of built-up insulations drops rapidly during the first minute but reaches a fairly uniform value after that time, the curves being very similar in shape for all insulations tested. Furthermore, curves obtained at different frequencies are fairly parallel, so that if the breakdown voltage is determined at one frequency it may be very accurately estimated for any other frequency. With the range of frequencies employed the dielectric strength of impregnated paper varied approximately as the reciprocal of the frequency and as the two-thirds to three-quarters power of the paper thickness. Commenting on the subject of these papers, Prof. V. Karapetoff called attention to the desirability of checking all breakdown data on insulation with the pyroelectric theories of Drs. Wagner and Steinmetz to prove or disprove the theory. Except at 25 cycles, the tests of both papers check very closely with the theory, Prof. Karapetoff said.

Meters and Measurements Featured

METERS and measurements formed the subject matter of one of the sessions on Thursday morning. In a good paper F. B. Silsbee discussed the subject of the testing of current transformers and gave details of eleven methods available, with their relative merits and demerits from an accuracy standpoint. The relative methods are preferred by the author for general use, and the two-ammeter and two-wattmeter methods are the simplest but the least accurate. For laboratory and precision tests the balanced absolute methods are recommended.

In the discussion which followed the paper the relative opinions as to the effect of simplicity, type of testing personnel and field conditions were accented as affecting the choice of test methods.

The next paper, by B. H. Smith and A. R. Rutter, described two new types of kva. meters. One was the commonly used two-element type with a kinematic mechanism for recording the kva.-hours on a graphic chart. The other type utilized a rotating ball and is described in detail in an article on page 333 of this issue of the ELECTRICAL WORLD.

The discussion of the new meters brought out the fact that commercial conditions and demands governed the type and accuracy requirements of kva.-meter design, and the authors and several who discussed the meters said that, although somewhat inaccurate under unbalanced conditions, the meters were commercially accurate under existing conditions of installation and use. The ball type created great interest, and in response to questions as to the effect of sudden changes in load, or power factor, it was stated that power-factor changes would be compensated usually, and if not, a variation of 150 per cent in any fifteen-minute interval would produce an error of only one-third of 1 per cent. The cost was given as approximately double that of a single watt-hour demand meter, and a demand contact may be attached, if desired, to either the kw. or the kva. register. The ball is one inch in diameter, is made of solid aluminum and weighs a little over one-half ounce.

Prof. A. E. Knowlton pointed out the inaccuracy of both meters for unbalanced loads, which, although not commercially of great importance, should be considered. He also raised the question of adjustments on the ball-type meter, but the authors declared adjustments could be made readily and that the ball itself needed no adjustments.

Seven methods for the automatic transmission of power readings were described in a paper by B. H. Smith and R. T. Pierce. The relative advantages and disadvantages of the methods were indicated and recent developments in the current, impulse and voltage methods were related. The suggested use of a thermocouple method was said by the authors to be objectionable because it would require very delicate receiving equipment when used over great distances. A trend toward telegraphic or impulse methods was indicated.

For precision measurements in dielectrics the quadrant electrometer was advocated in a paper by D. M. Simons and W. S. Brown. The authors described a new zero method of measuring power factor and also indorsed the use of the electrometer in a high-voltage bridge as a detector. The errors of the deflection and zero methods were discussed and dealt with quantitatively. The discussion brought out the fact that the electrometer could be used on high voltages satisfactorily and that the authors customarily use it at 7,000 volts, but have used it at 40,000 volts with 1,000 volts on the needle.

Losses of kilowatt magnitude can be measured by the instrument if desired. It is chiefly used as a laboratory precision instrument and for checking losses measured by a more rapid commercial method.

Latest Developments in Communication

TELEPHONE and telegraph engineers had a session on Thursday afternoon at which several papers were presented. Paul G. Andres traced the economic development of the step-by-step automatic telephone equipment since the paper by Campbell in 1911. The trend has been from mechanical to electrical control and operation, and very great improvements have been made in the system. The author said that the fundamental principles of design had been so sound and the commercial development so rapid that no great improvements could be expected in the near future.

A paper by W. H. Martin and H. Fletcher dealt with high-quality transmission and reproduction of speech and music. The general requirements to avoid distortion, the details of equipment used and the general broadcasting problem were discussed by the authors, who then demonstrated the paper for the audience by using laboratory equipment of the latest types. This equipment, while not yet available commercially, showed that almost perfect reproduction and reception of speech and music could now be obtained. The great problem is to reduce the cost so as to make the new developments more rapidly and readily adopted by commercial stations.

This paper was followed by a paper on the function and design of horns by C. R. Hanna and J. Slepian. The horn advocated was of the exponential type and was based on a very complete analytical development of the theory of horns. A demonstration followed the presentation of the paper which very successfully illustrated the effect of different elements in horn design and operation.

A paper by Dr. H. Nyquist treated of certain factors affecting telegraph speed. The author discussed the relative merits of various wave shapes used in signals and then discussed the codes by treating of the number of signal elements. He clearly indicated that the shape of the received signal is independent of the shape of the transmitted signal and further that the magnitude of the received signal will be about proportional to the area included within the impressed voltage wave. He also indicated methods for attaining greater transmission speeds by using a proper number of current elements and signal terms. The usual signal waves were then discussed and their limitations and applications outlined.

General George O. Squier discussed the paper at length and differed from the author by stating that wave definition and not wave energy was the all-important point in signal work. He then outlined briefly the method by which he arrived at his proposed signal codes and systems and predicted that very great improvements would follow their adoption.

Communication engineers had a session Friday morning devoted exclusively to the details of some of their problems. Four papers were presented, one by F. H. Best on measuring methods for maintaining transmission efficiency of telephone circuits, another on low-frequency signaling for radio telephony, by C. S. Demarest, Milton L. Almquist and Lewis M. Clement, a third by W. L. Casper on requirements of telephone transformers, and the remaining paper by R. L. Wegel and C. R. Moore, on a method of analyzing the harmonics in any wave.

Mr. Von Diller favored 3.5 to 5 per cent silicon-carbon steel for telephone transformers, saying that a loss as low as 1 erg per gram is obtained at 1,000 cycles and 10 to 15 gausses.

The wave analyzer described in the paper by R. L. Wegel and C. R. Moore was highly commended by at least two of those taking part in the discussion, Harvey Fletcher and L. P. Ferris. The former pointed out that the analyzer enables qualitative and quantitative analyses of any wave form in five minutes, compared with two or three months by methods formerly available. Mr. Ferris emphasized particularly the value of this analyzer to manufacturers of electrical equipment as a means of ascertaining whether apparatus developed will generate harmonics of serious magnitude, and if they do what their cause may be.

Machines and Their Operation

TWO papers on the ventilating problems associated with large generators were presented at one of the technical sessions on Friday morning. Carl J. Fechheimer described the models and told of the experimental results of a very thorough investigation of the quantities involved. He dealt with air distribution in machine ventilation, using axial, radial and circumferential ventilating designs. The effect of rotation was clearly indicated, and the results suggested means for materially improving existing ventilation designs. The axial-gap flow system was chosen as the best method for the large units.

Donald Bratt, in a companion paper, developed a mathematical foundation for the designing of ventilation systems, based on the experimental results. This, although somewhat approximate, was used successfully in commercial work. A good discussion followed which accented the principle that machine designers attempt to get a maximum output from a unit with the use of a minimum volume of materials. The ventilating of the machine and air distribution are tied in with heat generation in the unit in such a complex way that the two phenomena can be combined only with difficulty.

All parts of a unit should be cooled uniformly in the ideal machine, R. B. Williamson asserted, but commercial and design limitations force the modification of the ideal, although hot-spot temperatures must be limited definitely. In his opinion the simple axial ventilation was good for short units only. For larger units he thought the multiple-path ventilation system thoroughly satisfactory, particularly if ducts are used at the base of the teeth. The rotor, however, and not the stator, is, he said, the limiting element in ventilation, particularly for large units. A fundamental principle in the cooling of units is to get large volumes of cool air to the center of the machines. The use of

multiple-path ventilation, chamfering of laminations and other refinements indicated by the papers showed the possibility of successfully ventilating very large units.

Following these papers, P. C. Jones presented one on brush mounting. He developed the theory of brush mounting by mathematical and graphical treatments, indicating the ideal design with reference to the interrelation of upper and lower brush angles and the coefficient of friction. He said that a practical brush mounting used 60 deg. for the upper and 75 deg. for the lower angles. The discussion of the paper brought out the importance of considering operating variations such as rough commutators, brush material, speed, etc., in a study of brush mounting.

The theory of three circuit transformers was presented by A. Boyajian. He developed the complete theory of multiple-circuit transformers and showed that they could be represented by a multiple-network equivalent mesh. He also showed that the use of multiple-circuit transformers on transmission and distribution systems called for some definite precautions to avoid trouble. Mr. Boyajian also dealt with the usual three-circuit transformers and solved problems in regulation under any unbalanced loads, in line grounds and in line to neutral short circuits. The peculiar action whereby voltages may be raised or lowered under unbalanced loadings and the basis of load division between windings were discussed clearly. Some peculiar phenomena were outlined, such as those which follow:

"In a two-primary, one-secondary transformer the division of load between the two primaries is not as simple a matter as the usual rule of 'inversely as their impedances with respect to the secondary.' With certain coil arrangements one primary may carry practically the entire load regardless of the reactance of the other primary with respect to the secondary; and not only that, but simple coil arrangements are possible in which one of the primaries not only does not carry its share of the secondary load but itself draws power from the transformer and feeds it to its generator proportional to the secondary load. That generator and prime-mover characteristics affect the load division is, of course, true, and the division of load may be absolutely controlled thereby, but the peculiar phenomenon referred to is one which the characteristics of the transformer windings in certain combinations tend to impose, and it holds particularly true if the two generators are on one shaft or if the two circuits are connected in multiple to the same busbars.

In certain other cases load division may be indeterminate as far as the reactances of the windings go and be entirely determined by the resistances of the windings. This happens when two primaries are thoroughly interlaced.

"In case of a short circuit on the secondary of a transformer which has two independent primary circuits, the total short-circuit current is not necessarily the sum of the short-circuit currents which the two primaries would separately and independently produce.

"In a one-primary, two-secondary transformer, if one of the secondaries is loaded and the other is idle, the voltage regulation across the idle secondary may or may not be zero and may be positive or negative; i.e., the voltage may be lowered or boosted, depending, as before, on the arrangement of the windings.

"A somewhat common illustration of the difference in the regulation of two secondary windings is found in high-voltage testing transformers in which the inaccuracy of obtaining the secondary voltage by ratio from the primary is recognized and a special voltmeter coil is provided. The relative location of this voltmeter coil with respect to the primary and secondary determines the accuracy of the voltage readings taken from it."

In a discussion of the paper by A. Boyajian, P. L. Alger stated that the equivalent mesh circuit could also be used for induction motor studies.

Inspection and Visit to Bethlehem

On Friday, by special train, many members visited the Bethlehem Steel Works. An interesting incident of this visit was the use of a storage battery locomotive in the yards. This locomotive has been in use for several months and has given very satisfactory service, according to D. M. Petty, electrical superintendent of the company. Following the inspection trip the visitors were entertained by the Lehigh Valley Section at dinner, where President Richards of Lehigh and President McCracken of Lafayette gave addresses.

This visit was the climax to the entertainment and social features of the convention, which were admirably planned by the various committees. The ladies' entertainment committee, under the direction of Miss Eglin, provided cards, teas and theater parties for the visitors, and J. C. Lynch directed a splendid series of entertainments for other occasions, notably on Tuesday and Wednesday evenings. Unusual features of the dinner dance, which was directed by R. B. Mateer, was a motion-picture film showing convention activities, songs by prominent artists and a piano recital by Professor Karapetoff.

For those members who desired to make inspection visits Paul Spencer and his committee made arrangements, and many availed themselves of the opportunity to inspect various industries and engineering operations in and around Philadelphia. Notable among the exhibits was the locomotive exhibit of the Pennsylvania Railroad, where the largest and latest types of steam and electric locomotives were made available. Also at the Moore School splendid exhibits from various manufacturers and research laboratories aroused a great deal of interest.

The local convention committee, under its chairman, W. C. L. Eglin, had provided for every need of the visitors and the success of the convention was largely due to their efficient planning and active work.

Back Issues of Engineering Magazines Wanted for Japanese Libraries

IN RESPONSE to an appeal from the engineers of Japan the McGraw-Hill Company is endeavoring to assist them to rebuild their engineering libraries. The engineering industries in Japan, as a result of the loss in the recent earthquake, have been deprived of practically all their technical library equipment and facilities.

If readers of the ELECTRICAL WORLD will advise the editors what back files of engineering papers, bound or unbound, they may have which they are willing to donate to this cause, the ELECTRICAL WORLD will make the best collection possible from those available and will undertake to forward them to the engineering societies in Japan.

Modern Cable Practice

Comments by Representatives of American Manufacturers—Need of Research Into Insulation Problem Conceded by Leading Engineers in This Field —Latest Data on Characteristics and Test Procedure

IN THE ELECTRICAL WORLD for Dec. 22, 1923, page 1267, an extended account was published of an address upon European underground cable practice by D. W. Roper, superintendent street department, Commonwealth Edison Company, before the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers, emphasis being laid upon the conservative ratings of overseas cables and upon manufacturing methods abroad as observed during a trip to ten countries on the other side of the Atlantic last summer. Mr. Roper addressed the Boston Section of the Institute Jan. 17 upon the same subject in the presence of a large number of engineers employed by leading American cable manufacturers. In the following paragraphs is given a summarized report of additional points brought out, including comments by various manufacturing engineers upon this general subject.

REVIEW OF EUROPEAN METHODS

In reviewing his observations of European manufacturing methods, Mr. Roper pointed out that the resistance of insulating material to puncture at high voltages varies considerably as materials are used singly or in combination. Thus, a sample of paper insulation for lead-covered cable might puncture at 30,000 volts, a stated quantity of oil might resist up to 40,000 volts, and the combination of oil-insulated paper might puncture at 100,000 volts. The trend toward the use of new manila hemp-rope fiber in the manufacture of paper is marked abroad, and there is a wide use of wood sulphite or sulphate papers. Some difficulty is found abroad in impregnating the walls of manila hemp-rope fiber. European manufacturers test the porosity of paper by machine methods, measuring the baffling effect of the fiber in terms of the time required to force air through it. Wrinkles are troublesome in paper, tending to cause unequal strains in the material. Heavy mineral oil is generally used for impregnating paper in the United States, whereas in Europe from 10 to 50 per cent rosin is employed in many cases.

Touching upon the qualities of an ideal cable for 30,000 volts or over, Mr. Roper stated that the puncture voltage in a sample 10 ft. to 25 ft. long should equal or exceed five times the rated voltage on a five-minute test. After bending at — 5 or — 10 deg. C., the sample should withstand four times normal voltage for five minutes. Every reel should withstand three times normal voltage for five minutes, and reels tested at random should stand double normal voltage for four to ten hours without failure or the development of local hot spots.

DEFECTS FOUND IN CABLE WORKMANSHIP

In the study of cables Mr. Roper has found many defects in workmanship, and a number of these are summarized in the following paragraphs:

1. In preparing strips of insulating paper some manufacturers tear the strips as a result of using a dull tool. This is conducive to edge tears. The edge tear is also obtained by applying paper insulation conically instead of flat.

2. In bending the edges of the layers the paper is sometimes sheared down the middle.

3. Some manufacturers put on layers of paper in one direction, then reversing. This leads to diagonal and edge tears.

4. Paper is sometimes put on without lap. This does no harm if gaps are not left in series, but the speaker has found cases where the paper-taping machines were not properly adjusted and has counted as many as ten gaps in series out of twelve layers in two intervening papers.

5. In modern cable sometimes the paper is dried at too high a temperature; the filler may be distributed unevenly through the cross-section; the paper may creep, and in some cases the lead sheath may not be continuous, although it looks so to the eye. Bending in the manhole may strip the covering in such instances, especially if the lead is put on too cold.

Other trouble arises in some instances from the grade of paper changing to one unsuitable for cable work, or the quality of the oil may change. A factory may lose two weeks' production if this is not discovered in time. If both these troubles come together, the quality of the cable drops fast. Sometimes air gets into the surface and outer layers while draining and is carried along as the cable passes into the lead press. In some foreign plants the cable passes directly from the oil to the lead press. Again, the insulating compound is sometimes unstable. With a magnifying glass black spots may be found and removed with a toothpick, these increasing the dielectric loss from 15 to 180 per cent. Since June, 1923, Mr. Roper said, 60,000-volt underground cable has been giving satisfactory service in England.

MANUFACTURERS DISCUSS CABLE PROBLEM

E. W. Davis, assistant electrical engineer Simplex Wire & Cable Company, Boston, emphasized the trend toward higher-voltage cable practice. He stated that the wide variation of the electrical constants of high-voltage cable material that must be used to convert mathematical formulas into practical results makes the certain prediction of satisfactory cable operation somewhat hazardous, especially cables for the so-called supervoltages.

Recently the Simplex company manufactured as a part of its regular factory routine seven 150-ft. lengths of No. 6 solid, $\frac{7}{32}$-in. wall-impregnated paper insulation with $\frac{1}{16}$-in. lead sheaths. All seven lengths of cable were vacuum-dried and saturated at the same time, thus insuring the same variations in constants due to manufacturing process or impregnating compound. The impregnating compound used was a mineral base compound without rosin.

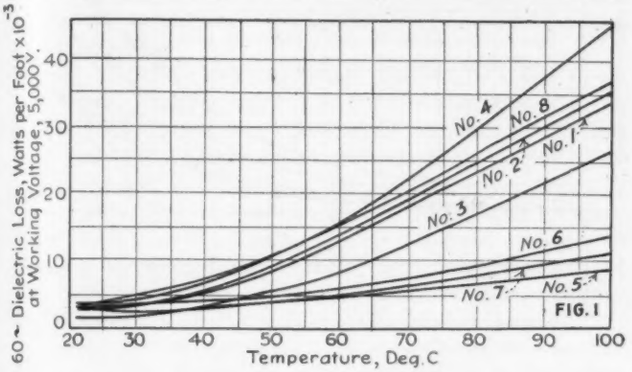
The paper used on each length of cable was of a dif-

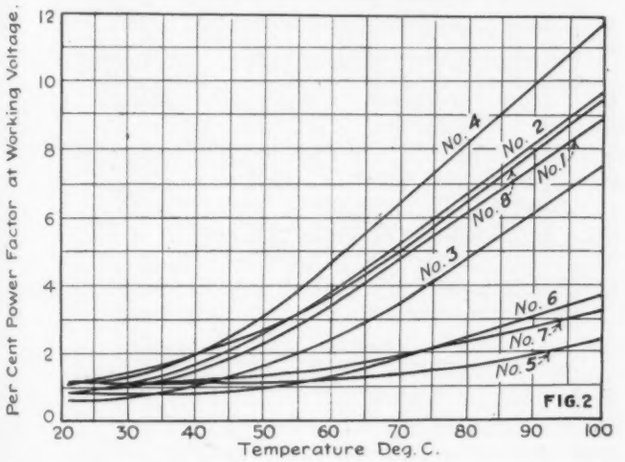
ferent type of high-grade insulating paper, seven different types from three makers being employed.

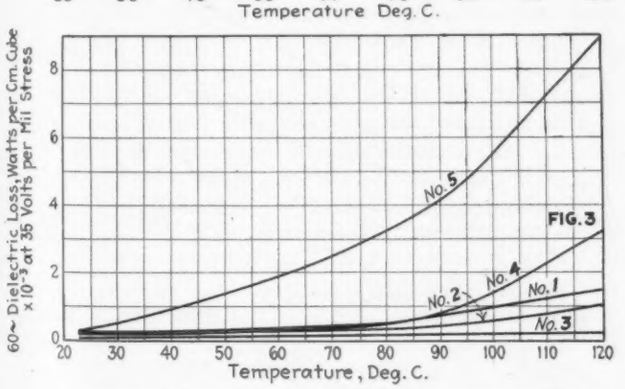
The dielectric strength tests on these samples were not very conclusive, as 6-ft. samples of each withstood 100,000 volts alternating current between conductor and lead, even after being subjected to bending, freezing and heat tests.

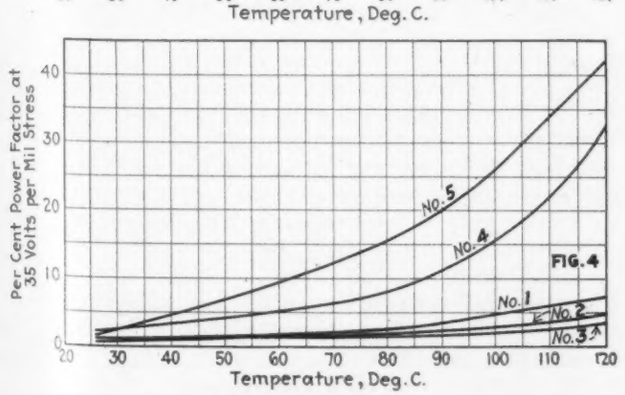
It is interesting to note, however, that all of these samples showed a dielectric strength of at least 940 volts per mil (or 370 kv. per centimeter) as compared with similar tests on identical samples impregnated with a compound which consisted of a large percentage of rosin where the average breakdown was only 600 volts per mil (or 237 kv. per centimeter).

The thermal resistivities of the samples of cable with seven different types of paper showed rather wide range—varying from 400 deg. to 1,200 deg. C. per watt per centimeter. In general the high thermal resistivities were found where the thin papers of 5-mil thickness were used, rather than the normal 7-mil paper.









TESTS ON DIELECTRIC LOSS AND POWER FACTOR OF POWER CABLES

Fig. 1—Dielectric loss versus temperature, 20-80 deg. C.
Fig. 2—Power factor versus temperature, 20-80 deg. C.
Fig. 3—Dielectric loss versus temperature, various petrolatum greases.
Fig. 4—Power factor versus temperature, petrolatum greases of Fig. 3.

Dielectric Loss and Power Factor

The results of tests for dielectric loss and power factor can be best shown by curves. The tests were made at 5,000 volts, 60 cycles, with a sine wave.

Fig. 1 shows curves of dielectric loss versus temperature for a temperature range of from 20 deg. C. to 100 deg. C. At 80 deg. C. (maximum working temperature for this cable) the dielectric loss varies from 6.3×10^{-3} for No. 5 paper to 29×10^{-3} for No. 4 paper, a range of approximately 460 per cent.

Fig. 2 shows curves of power factor versus temperature for the same temperature range. It will be noted in this figure that the range of power factors is a little greater than was shown for the dielectric loss—namely, at 80 deg. C. 1.6 per cent to 8.4 per cent, or approximately 525 per cent. These variations were all caused by the different types of paper used. The papers showing the lowest values of dielectric loss and power factor proved on subsequent tests to be the poorest as to mechanical properties—Nos. 5, 6 and 7 showing from fourteen to twenty-five tears on the bending test, while Nos. 1, 3, 4 and 8 showed no tears at all.

Test of Petrolatum Greases

Tests on various petrolatum greases used in impregnating compounds have shown the results given in Figs. 3 and 4.

These greases were prepared for test by subjecting them to exactly the same drying processes, being very careful to maintain temperatures below values that would "crack" or otherwise injure them. The greases were tested in a special apparatus designed for this purpose, wherein most possible errors are eliminated. All these greases were tested at the same time, thus insuring the same temperature conditions. It will be noted in Fig. 3 that while No. 5 grease shows a very marked increase of dielectric loss with temperature the No. 3 grease shows little or no rise with temperature.

Fig. 4 shows the curves for power factor for the petrolatum greases as shown in Fig. 3. No. 3 grease shows little or no variations in power factor over the working temperature range of a cable, while the No. 5 grease shows an increase of from 1.5 per cent to 15 per cent from 25 deg. C. to 80 deg. C.

Tests were also made on a 150-ft. sample of single-conductor, 400,000-circ.mil cable for operation on a 66,000-volt grounded-neutral system. The operating voltage to ground for such a system would be 38,200 volts, and it was for this voltage that the cable was designed. The insulation was a 24/32-in. wall of impregnated paper.

The 150-ft. length was subjected to a 100,000-volt alternating-current test for two hours and sixteen minutes without failure or any evidence of damage to the insulation. From 100,000 volts the pressure was raised by 5,000-volt steps to 130,000 volts, where arcing over on the ends stopped the test.

A 15-ft. sample was subjected to bending and freezing tests and then to a 100,000-volt test for five minutes without failure. The pressure was then raised by 5,000-volt steps to 120,000 volts, where arcing over on the ends stopped the tests.

A later test made on the 150-ft. sample with a different design of end bells resulted in a breakdown at the end of the lead sheath at 105,000 volts. This breakdown, however, was due to excessive static discharge due to poor end-bell construction.

Figs. 5 and 6 show dielectric loss and power-factor observations at various voltages and temperatures. At 60 deg. C. and 38,200 volts the dielectric loss is only 0.47 watt per foot, while Fig. 6 shows that the power factor at this point is only 1.8 per cent.

VARIATION OF DIELECTRIC LOSS WITH TEMPERATURE MEASURED

Fig. 7 shows curves of dielectric loss against temperature. With the voltage designated the dielectric loss at 50 deg. C. is the same or slightly less than at 20 deg. C., while at 60 deg. C. and 40 kv. the dielectric loss is only about 10 per cent higher than at 20 deg. C. This indicates that for this particular cable the operator need not worry about the dielectric loss over the working temperature range of the cable. A second sample from the other end of the 150-ft. length of cable gave results that were quite consistent with those shown by these curves.

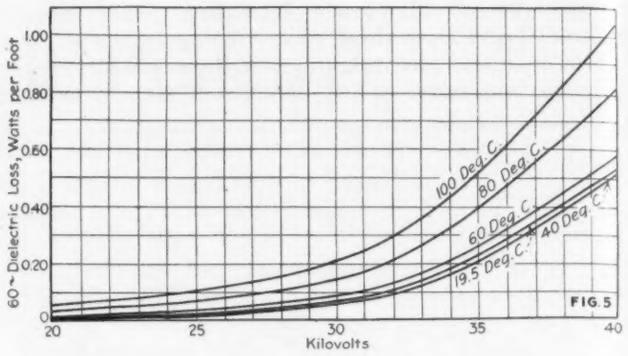
Fig. 8 gives a concrete example of the theoretical curves of Bang and Louis, published in the *A. I. E. E. Journal* a few years ago. It shows the effect of the dielectric loss and lead-sheath loss on the allowable copper loss if the cable just discussed were installed in a 66,000-volt grounded-neutral system. The angle for the heat-dissipating curve of the duct has been assumed at 40 deg. At 60 deg. C. the dielectric loss is 16 per cent of the heat-dissipating value of the duct line. This results in a reduction of only 16 per cent in the allowable copper loss. There is, however, an additional loss that must be considered unless elaborate precautions are taken to eliminate it. That is the loss in the lead sheath due to induced currents, which in this particular case would amount to about 22 per cent of the allowable copper loss.

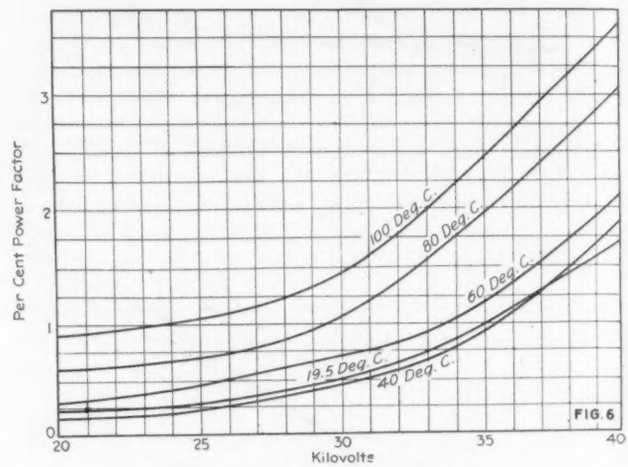
In calculating the safe load that such a cable may carry each of these losses must be accounted for, or otherwise overheating of the cable may result.

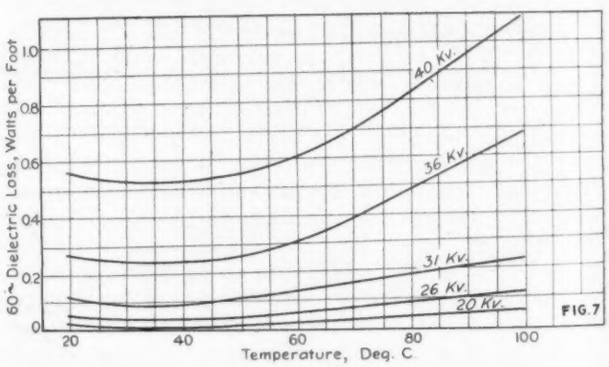
PROBLEMS THAT CONFRONT MANUFACTURING ENGINEERS

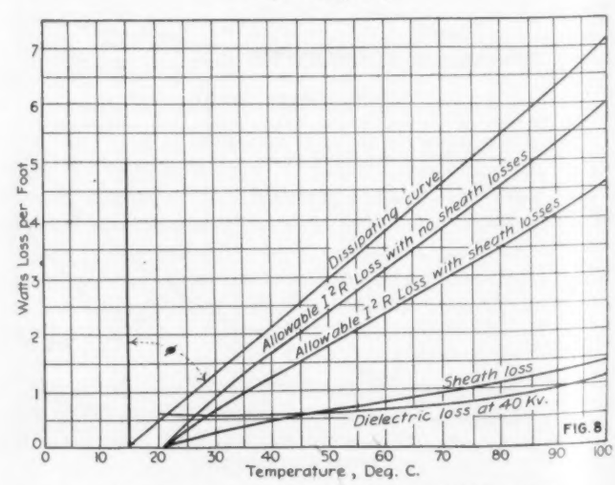
The engineer is confronted with very serious problems in the design of extra-high-tension cables. The engineer for the manufacturer must carefully choose and treat his materials, using only such papers and impregnating compounds as will result in the best electrical and mechanical properties for the finished cable. The engineer for the operator must carefully account for the heat dissipation of his duct lines and make due allowances for dielectric and lead-sheath losses in determining the safe load for his cables.

E. G. Allen, consulting engineer for Stone & Webster, instanced the increased capacity per cable circuit which









CABLES TESTED WITH AS HIGH AS 130,000 VOLTS

Fig. 5—Dielectric loss versus voltage, single-conductor, 400,000-circ.mil cable.
Fig. 6—Power factor versus voltage, cable of Fig. 5.
Fig. 7—Dielectric loss versus temperature, cable of Fig. 5.
Fig. 8—Effect of dielectric loss and sheath loss on allowable copper loss. Cable of Fig. 5 installed in 66-kv. grounded-neutral system.

would follow the use of high voltages. If the maximum capacity per circuit be assumed as 5,000 kw. at 13,000 volts, this would rise to probably 25,000 kw. at 66,000 volts, and this is a factor to consider in connection with the rapid growth of central-station loads and advent of superpower.

W. A. Del Mar, chief engineer Habirshaw Cable Company, New York, pointed out that in recent tests sector cables with creases in the paper insulation did not break down at much lower voltage than cables with smooth paper, notwithstanding the fact that there is 40 per cent less dielectric strength in creased as compared with uncreased paper. This company abandoned the use of rosin because it is chemically unstable at high temperatures. American cables are run at higher temperatures than European. The power factor of in-insulating materials is not proportional to the square of the voltage, recent investigations indicating an index of 2.1 or 2.2 for dielectric loss.

A 44,000-Volt Cable in Active Service

G. M. Haskell, vice-president Safety Insulated Wire & Cable Company, New York, said that the demand for high-voltage cable is two or three years old and that good progress is being made by manufacturers in meeting requirements. A considerable quantity of 33,000-volt to 35,000-volt cable is in operation, also 44,000-volt single-conductor cable, and in the near future an installation of 66,000-volt cable will be in service at Cleveland.

F. M. Farmer, Electrical Testing Laboratories, New York, contended that the minimum length of 300 ft. to 400 ft. in test sections is an obstacle to testing. A 10-mile, 35,000-volt, 350,000-circ.mil cable in service has about 35,000 sq.ft. of insulation exposed all the time to potential compared with 200 sq.ft. to 300 sq.ft. of insulation in a generator or transformer. Quality of insulation is the chief point of interest in high-voltage cable. Mr. Farmer said that the electrical industry is only beginning to learn the fundamental facts about insulating materials as related to breakdown in service. Cable inspection for defects which may patently cause trouble is a part of the laboratory's work, but so far the tests available are largely of the "blacksmith" type. It cannot as yet be foreseen what cables will do in service, and tests are needed which will predetermine insulation quality. It appears that the most helpful line of attack is the variation of power factor with voltage. It may be feasible to specify the limit to the amount of power-factor increase above a stated voltage change. Tests show a considerable change in power factor after heating cable and draining off the compound. A 60,000-volt section at room temperature showed a power factor of 2.3 per cent before and 4.7 per cent after draining, and a 10,000-volt cable showed corresponding power factors of 0.4 and 4.7 per cent.

Time Needed for Development Work

J. L. R. Hayden, General Electric Company, said that time is needed to develop cables for high-voltage work. There is more in the problem than the use of rosin. Prof. V. Bush, Massachusetts Institute of Technogoly, said that a research on behalf of the National Electric Light Association into the deterioration of cable with temperature is under way at the institute but has not progressed far enough as yet for results to be stated.

E. D. Eby, Pittsfield, Mass., urged the value of research engineering rather than empirical tests in cable development. He pointed out that the cable joints made by operating companies are not so good as the cables themselves. Stress calculations with the slide rule show the location of weak spots and check closely with operating experience. Too much reliance on "cut-and-try" methods is placed at present in cable practice. Mr. Roper said that the fact that rosin is unstable at high temperatures is not a sufficient reason for its non-use. Experience has shown that a cable having the least increase in dielectric loss with age was one with the largest percentage of rosin in its insulation.

It Pays to Study the Human Element

An Examination Into the Cash Value of Good Public Relations and also Its Influence on Company Personnel

By E. L. Milliken
Assistant Manager Blackstone Valley Gas & Electric Company, Woonsocket, R. I.

POOR public relations adversely affect net earnings. There are executives in the industry, however, who are skeptical as regards the wisdom of the so-called "public relations" program. Many feel that it is being overdone—that the public should not be continuously fed on the expressed desire of the industry to improve its relations with them. Others believe that the results are problematical. Still others view their local situation with complacence, lulled into a false sense of security because there is no outward evidence of public disfavor. And still others there are who feel that the study of the human elements of the industry cannot be made to produce a return in actual dollars.

As regards the feelings of the first group, let us emphatically admit their contention. We have overdone the publicity in connection with our public relations program. Instead of telling the people, our customers, that we want their good will, let us rather proselyte ourselves, to the end that we all may profit. For the good will of the people can only be obtained by so conducting our business as to deserve good will, and not by shouting from the housetops the fact that we must have it.

To those who are cocksure of their public it is submitted that this feeling may have come about through a satisfactory political situation, but—politics and public relations are two different matters. Politics deals with the relations with a few in power today and perhaps gone tomorrow, while public relations deals with the people—the electorate—today, tomorrow and for all time. This is no new theory. Did not George II of England once remark to Edmund Burke: "You have taught me to look for the voice of my people in other places rather than within the House of Commons!"? The psychology of the few is far simpler than that of the masses. The company whose public relations are good need have no fear of the veering of the political weathervane, while, on the contrary, fair political weather does not necessarily presage that the public is pleased.

Coming now to those who view the effects of the public relations program as problematical and not certain to net a financial return, some typical ways in

which good public relations actually save a utility money deserve consideration:

1. *Less Money Spent on Rate Hearings.*—Has not the company whose public is dissatisfied with the service been put to needless legal and other expense when called upon to defend its rates and service standards before a public service commission? Appraisals, attorneys' retainers, expert opinion and, last but not least, the time of its officials, which might more profitably be spent on the other always urgent problems of finance, operation, management or engineering, all cost good money. Attention to the little civilities and courtesies of service will go a long way to smother at their inception movements of discontent which otherwise might be fanned into the flames of rate agitation. Study of our rate cases and the evidences submitted by the complainants can lead to but one conclusion, namely, that back of most of them is originally some failure properly to serve which is more influential than the monetary considerations involved.

True, the politician thrives on rate agitations and holds forth the savings possible to the public as a lever to raise public opinion on his side. But if this opinion is not found to be on his side he soon rides another hobby, and it will not be with him where the public is well served. So the money saved by forestalling rate controversies is a decided credit on the public relations ledger.

2. *Financing Made Easier.*—It costs money to raise money, and the harder the money comes the more it costs. Our industry is and will be forever raising money. How much easier it comes when a satisfied public, having confidence in its local company, becomes a partner through customer ownership! And such a company can also the more easily raise outside its territory such funds as are beyond the capacity of the territory to produce. Investors favor securities in companies having a large number of customer security holders. Such a condition makes for stability of both principal and income. When customers have confidence investors have also, and when a company reaches such a condition it is usually not a question of how much money can be raised, but rather of how much stock can be obtained to meet the demand. The result is that money is hired at relatively low rates.

Fostering good public relations alone can produce this confidence on the part of customers in the management of a company. Thus it is possible again to place as a credit item the money saved through financing at a lower rate.

3. *Complaints Cost Less.*—To handle service complaints entails expense. All complaints have a real justification in the mind of the customer, yet the majority of them when finally analyzed have little physical justification. Many are due to imaginary grievances, either past or present. Yet psychological though their origin may be, nevertheless they must be investigated. They take up the time of company's people from the office boy to the general manager. Automobile mileage piles up in the endeavor to satisfy; meters are tested, cut out and new ones installed; correspondence ensues. All this costs money and sometimes to no avail, because lurking in the back of the customer's mind is a suspicion of ill will that will not be quenched.

If improving contact with customers (which is really what public relations has come to connote) will eliminate this latent spark of antagonism, money is saved, to say nothing of everybody being happier all around. A month's salary expended for preventing complaints is worth a year's salary trying to satisfy them after they develop. So a third credit appears on the ledger.

4. *Right-of-Way More Easily Secured.*—Maybe a company has occasion to acquire right-of-way for lines. Perhaps its policy has been short-sighted in refusing justifiable extensions into outlying districts. Some land owners who would otherwse be customers own some of the land needed. The price expands to make up for inconvenience suffered and failure to get service. As a result, to the company's investment is added a higher amount for land or easements than would otherwise be the case.

Failure to sense the pulse of the people costs money in the end. If saved by contrary practices, it is surely a credit in actual money.

5. *Collections Come Easier.*—A satisfied public will pay its bills more willingly. Grouchy customers are not usually prompt pay. Every time we have to go after our money with collectors it costs money. Collectors are not a factor in collecting from prompt customers. So pleasant relations will reduce collection expense.

6. *Sales Resistance Reduced.*—It is always easy to sell more goods to satisfied customers. Increased use of service will come from those who are well disposed toward any company. For service when well rendered gives the sensation of value received and brings an appetite for more of the service. Undoubtedly the customer whose contact with us is satisfactory to him is a freer user of our service.

Increase in gross earnings—in other words, increase in sales to customers—may be said to follow "the Ohm's law of sales," which is:

Customer buying (kw.-hr. takings) = effort ÷ resistance.

By effort we refer to sales effort. Resistance is the commonly called sales resistance. Sales resistance depends largely on the attitude of the customer. The dissatisfied customer will not increase his takings of service except through exceptional sales effort, and even then with reluctance.

Now, sales effort costs money in proportion to the degrees of effort. If we can through improved contact with our customers change antagonism against us to enthusiasm for us, sales resistance is reduced to a minimum, dependent solely on the customer's ability to pay. It will then cost less to sell ever-increasing quantities of satisfactory service. To some extent the service will sell itself. Thus it would seem clear that a company serving a satisfied public is in a position to increase its business at a satisfactory rate with minimum sales expense.

Conversely, if sales resistance resulting from an ill-served public exists, then no reasonable increase in cost of sales effort will bring this much-to-be-desired increment in takings by present customers. The company can only increase its business by adding customers, frequently located off existing lines, who necessarily must have the minimum of service. Obviously the most profitable increase comes from customers already connected.

In view of this it is submitted that the betterment of public relations offers an opportunity of increasing gross income with consequent smallest sales expense per additional unit of business secured.

7. *Organization Personnel More Contented.*—Turnover of personnel involves an actual expense in operation of which a portion can only be saved by reducing such turnover. Again, the cost of the turnover increases as it comes to involve the higher types of personnel in a company's organization. For the higher types of men and women employed in our industry have more zest for their daily work, are more satisfied with their positions and work at better efficiency if the employing company is in the good graces of the community served.

Consider, for example, the mental state of a cashier at the end of a day's work replete with complaints from consumers—one who has been called upon to pacify irate people all day long, not hearing a word of praise for his employer from morning until night. When he goes home can he feel other than convinced that his employer is at least in part what the customers claim? Can he take that pride in his work essential to joy in it? Rather does he wonder whether he may not suffer similar treatment in turn. And so, when enough such days succeed each other, he balances his cash some night and quietly slips into another and more congenial atmosphere in which to labor.

Reverse the conditions and the same cashier finds joy in the contact with hundreds of "friends" daily. He becomes, in his own mind, part of a public-serving organization. His self-respect is retained, and he works faithfully and well, looking toward the day when for him opportunity will knock at the door of the same house. It is only logical that a company which so treats and meets its customers as to inspire their confidence should likewise treat its employees fairly and with due regard to their welfare. Such a company will have a lower payroll turnover, with a consequent saving of expense.

Yet this is not the only saving from a personnel standpoint. While the more enlightened and capable employees naturally live in anticipation of greater remuneration, yet by virtue of their intelligence they also perceive that wages or salaries are but a part of their compensaton. The company which considers the human element in its relations with employees and customers can usually obtain the services of men and women at somewhat less cost than a company which disregards this element and treats its employees as mere cogs. Good service cannot be given with dissatisfied, indifferent employees.

These are but a few ways in which improved contact with customers can mean either increased gross earnings or lower operating expenses. The cost of improving the contact is perhaps a little time and effort on the part of existing managing and supervisory officials. The increase in net earnings is certain to accrue.

Ball Type of Kva. Meter

New Mechanical Arrangement for Getting the Root Mean Square of the Watt and Wattless Components to Obtain Kilovolt-Ampere Readings—Can Also Measure Kilowatt Demand

By B. H. SMITH
Engineering Department, Westinghouse Electric & Manufacturing Company

IN SELLING large quantities of electricity for mills, factories, stores and various industrial applications, and also for measuring the interchange of power between different power companies in order to make rates equitable and satisfactory to both producer and consumer of electrical energy, other factors than watt-hours must be taken into account. It is generally recognized that the demand or service charge which is a measure of the quantity of equipment that the power company must maintain for a given customer should be based on kva. (or kilovolt-amperes) and that the quantity of power units consumed should be based on kw. (or kilowatts).

There are several ways of making kva. measurements, but perhaps the most generally satisfactory and accurate method is by taking the vector sum or square root of the sum of the squares of the "watt" and "wattless" components in the polyphase circuit. The first may be measured by an ordinary watt-hour meter, and the second may be measured by the same kind of watt-hour meter, but with a voltage connection such that the voltage applied to the meter is 90 deg. out of phase with the voltage used for the watt-hour meter.

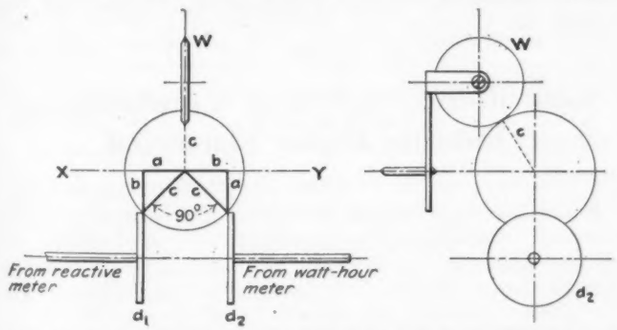


FIG. 1—MECHANICAL RELATIONS BETWEEN WATT-HOUR AND REACTIVE METER ELEMENTS AND CONNECTIONS TO THE BALL MECHANISM
Illustration shows conditions for 70.7 lagging power factor.

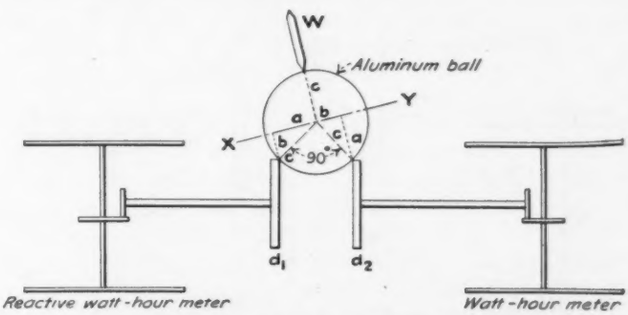


FIG. 2—CONDITIONS WHEN THE WATT-HOUR ELEMENT ROTATES FASTER THAN THE REACTIVE ELEMENT SHOWS THE MECHANICAL FREEDOM OF THE ELEMENTS
For leading power factors the reactive element reverses.

Since sine squared plus cosine squared are equal to one, it is readily shown that volts times amperes is equal to the square root of the sum of the squares of the two components mentioned above. There have been several mechanical methods devised for obtaining this vector addition, and a new and interesting kva. meter utilizing the ball method affords a very satisfactory and simple device for securing the desired vector addition. Fig. 1 is a diagram showing the mechanical relations between the watt-hour and the reactive meter elements with their connections to the ball mechanism. Through small bevel gears the wheel consisting of a ¼-in. disk of aluminum, d_2, is driven by the watt-hour meter, and similarly d_1 is driven by the reactive-watt-hour meter. Let it be supposed for a moment that the two meters are running at equal speeds, then it is evident that if the ball is supported by a third wheel, w, it will rotate about an axis xy in the plane of the paper such that the radii a and b, drawn from the axis of rotation to the points of contact of the disks d_1 and d_2, will be equal and the axis, xy, will be horizontal. In Fig. 2 the watt-hour meter is running slightly faster than the reactive meter and the radius a is greater than the radius b. The two disks are set so that the angle between their points of contact and the center of the ball is 90 deg. Then the two triangles abc are equal. Considering either one of these triangles, it is evident that c, the radius of the sphere, is the vector sum of a and b, or from the law of the right triangle c is equal to the square root of a^2 plus b^2, which is the vector sum. This is true for any power factor.

The wheel, w, is mounted in a frame which moves about an axis perpendicular to the paper and passing through the center of the ball, so that as the axis of rotation of the ball shifts the position of w changes so that it always rotates on a great circle and its speed is then proportional to the radius of the ball. Thus there is an integrated motion which is the vector sum of the watt-hour-meter motion and the reactive-watt-hour-meter motion, and it represents, therefore, kva.-hours. Through suitable gearing the wheel, w, is connected to a pointer which registers kva.-hours, and if the pointer is reset say every fifteen minutes, one obtains the fifteen-minute demand.

Fig. 3 shows the condition at unity power factor. Since the reactive-watt-hour meter has its voltage connections 90 deg. out of phase with a normal watt-meter connection, at unity power factor the reactive meter is at rest, the disk, d_1, is stationary and the axis of rotation of the ball passes through the point of contact of d_1. The radius, a, is then equal to c, the radius of the sphere, and it is evident that a one-to-one ratio exists between the watt-hour meter and the kva. ele-

ment. In other words, kva.-hours are equal to kw.-hours at unity power factor. Fig. 4 shows the position at zero power factor where the watt-hour meter stands still and the reactive meter runs at maximum speed. The radius, b, is now equal to c, the radius of the sphere, and the kva.-hours are equal to the reactive watt-hours. For any condition between these two limits the wheel, w, runs at a greater speed than either d_1 or d_2 and its speed is the vector sum as mentioned before. If the power factor is leading, the reactive

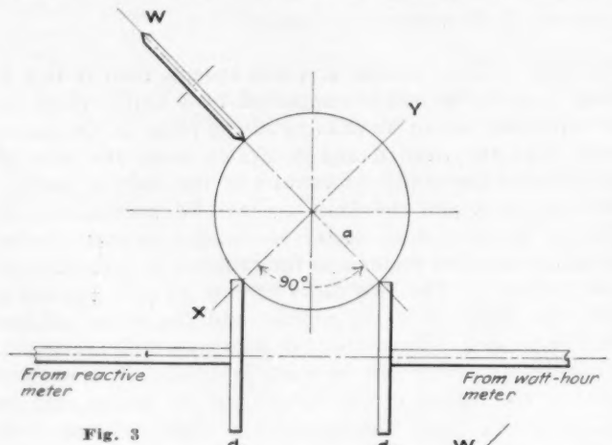


Fig. 3

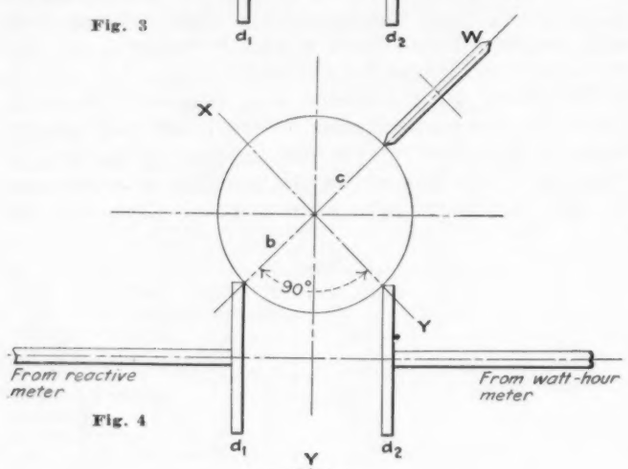


Fig. 4

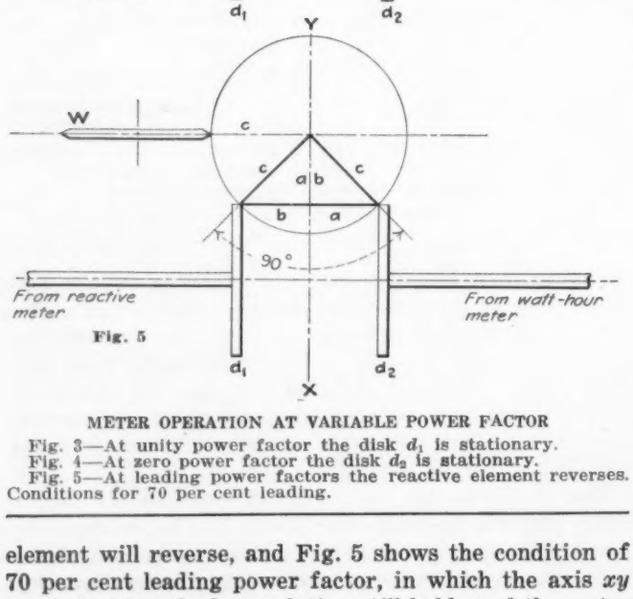


Fig. 5

METER OPERATION AT VARIABLE POWER FACTOR

Fig. 3—At unity power factor the disk d_1 is stationary.
Fig. 4—At zero power factor the disk d_2 is stationary.
Fig. 5—At leading power factors the reactive element reverses. Conditions for 70 per cent leading.

element will reverse, and Fig. 5 shows the condition of 70 per cent leading power factor, in which the axis xy is vertical but the kva. relation still holds and the meter will operate correctly over a range from about 50 per cent leading power factor to zero lagging.

There might be some question of slippage in a friction drive of this sort, but measurements show that the power required to operate the pen and kva. counter mechanism is only one-eighth of the power required to slip the wheel, w, on the ball.

It is often advantageous to have the kw. demand at the same time as the kva. demand, and Fig. 6 shows how this is taken care of on one paper chart in the meter under consideration. The length of line on the chart represents the kva. demand and the small mark just below each line is an indication of the kw. demand. This is obtained by arranging a mechanism on the kw. element which causes the pen to hesitate a fraction of a second during the process of resetting and make a mark on the paper. Since kva. is always greater than kw., there is no possibility of the kw. mechanism advancing ahead of the kva. mechanism. In the complete meter, there are watt-hour dials connected to the watt-hour element and also kva.-hour dials. A small frame supports the wheel, W, in the ball mechanism which carries the pointer indicating the power factor, since for every power factor there is a difference in the relative speed of the two meter elements and a corresponding position for the wheel, W.

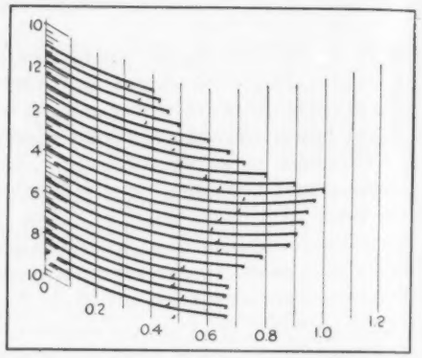


FIG. 6—MEASURING KW. AND KVA. DEMAND ON ONE CHART

Horizontal lines show kva. demands and dots show kw. demands.

Agricultural Implement Manufacturing Industry Highly Electrified

THE large extent to which electrical energy is being used as a source of power in the factories of the country manufacturing agricultural implements is clearly indicated by the returns received by the United States Census Bureau. There are 521 factories of this industrial group using mechanical power of some type or types. The primary power of these factories totals 128,249 hp., of which 47,842 hp. is purchased from central stations. A very large proportion of the prime-

DISTRIBUTION OF POWER IN THE AGRICULTURAL IMPLEMENT MANUFACTURING INDUSTRY—U. S. CENSUS OF 1919

State	Number of Establishments Reporting	Power						
		Primary Horsepower						
		Total	Steam Engines	Steam Turbines	Internal-Combustion Engines	Water Power	Electric Horsepower Purchased	Electric Horsepower Generated in Private Plants of Industry
United States...	521	128,249	51,107	18,835	4,092	6,373	47,842	52,421
Illinois.....	68	54,608	22,000	10,134	72	1,090	21,312	24,979
New York.....	40	12,736	5,619	1,512	601	1,696	3,308	5,794
Indiana.....	29	10,864	3,848	3,350	73	2,025	1,568	7,516
Wisconsin.....	34	10,673	5,953	2,375	163	0	2,182	5,903
Ohio.....	46	10,470	4,170	1,433	1,565	220	3,082	5,893
Michigan.....	23	6,197	2,993	0	50	0	3,154	332
California.....	34	4,668	95	0	616	0	3,957	164
Pennsylvania...	27	3,006	1,935	0	1,565	220	3,082	5,893
Iowa.....	26	2,396	305	0	99	0	1,992	2
Kentucky.....	8	2,073	653	0	31	0	1,389	0

mover rating in these plants is used in the production of electrical power, the total electric horsepower produced in private generating plants totaling 52,421 hp. The total electrical horsepower used in the agricultural implement manufacturing industry, therefore, is 100,263 hp. The distribution of power in the agricultural implement manufacturing industry is given in detail in the accompanying table.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Should Utility Stockholder Lists Be Published?

To the Editors of the ELECTRICAL WORLD:

Some time ago an editorial appeared calling attention to the desirability of printing a list of stockholders in utility companies. I think the reason these lists have not been published in the past is not a desire on the part of the companies to keep them secret so much as a feeling of courtesy and responsibility to the stockholders. The idea of publishing the names of the owners of a property has an attractive sound and appears, superficially, to be good public relations policy. It has the serious objection that once the list was published stockholders would at once become the targets of promoters of fake enterprises and advertising schemes of all sorts. The plan might, therefore, have a negative rather than a positive effect and should be studied carefully before being carried out.

Utility stockholder lists have now become so large, in many cases containing more than a hundred thousand names, that it is a question whether they would make very interesting reading material.

Chicago, Ill. RALPH W. LIDDLE.

Removal of Limitation on Use of Squirrel-Cage Motors

To the Editors of the ELECTRICAL WORLD:

The inertia of matter is one of the most important factors entering into engineering calculations. However, the inertia of the human mind is probably even more influential in determining the course of engineering developments. All are familiar with the fact that a practice once established for sound technical reasons often remains in force long after these reasons have ceased to exist. The practice becomes a "policy," and the inertia of the mind resists any tendency to change, frequently causing great delay in the development of the industry.

A number of years ago central-station companies for good and sufficient reasons adopted as their policy the requirement that squirrel-cage motors above 5 hp. must be provided with compensators before they can be connected to their power lines. The cost of a compensator is stated to vary between 20 per cent and 70 per cent of the cost of the motor, 40 per cent being probably a good average.

In a paper, "The Starting of Polyphase Squirrel-Cage Motors" (*Journal A. I. E. E.*, November, 1923) Prof. Benjamin F. Bailey has shown that the conditions responsible for this requirement are now, from the standpoint both of motor and line, largely non-existent. He presents very strong arguments for the removal or great extension of this limitation on the use of squirrel-cage motors.

It does seem that motor users are entitled to the economic benefits which would result from the changes suggested by Professor Bailey in the requirement of central stations with reference to the use of compensators, or good reasons should be given for continuance of the present policy. K. L. HANSEN.

Milwaukee, Wis.

Wide Advantages of Good Highway Lighting

To the Editors of the ELECTRICAL WORLD:

With reference to the letter of E. J. Del Vecchio published in the ELECTRICAL WORLD of Dec. 22, 1923, in which he opposes the lighting of highways by electricity, I take issue with him on five points which seem to constitute the basis of his argument.

Mr. Del Vecchio claims that "highway lighting is little more than competition with the stars." Evidently Mr. Del Vecchio has not seen some of the recent highway installations. If he had, he would have compared them to moonlight. He states that there are only three classes that can be benefited by highway lighting, pedestrians, those using horse-drawn vehicles and those using motor vehicles. I fail to see that he has an argument in this statement as his three classes include every one.

Granting that the highways are used chiefly by motorists, Mr. Del Vecchio states that "most motorists will agree that any kind of light except their own works to their disadvantage." It is obvious that daylight conditions represent the desired goal. The nearest approach to this is found in the scientifically designed system for lighting highways. As to whether it is advantageous or disadvantageous to the motorist, one would like to have Mr. Del Vecchio consider how highway lighting can prevent accidents by showing up dangerous curves, by illuminating signs, sides of roads, ditches, obstacles, etc. Look at an approaching motor car first without and then with highway lights. In the first case the glare from the headlights of the car will eliminate everything else from view. In the second case the glare is quite bearable and the car may be seen very easily. Highway lighting also adds to the comfort of night driving by relieving eye strain, by rending it easy to make repairs and by discouraging hold-ups.

Is the agitation in favor of highway lighting based solely on the claim that it will benefit motorists? We believe that it is a factor in national development. Highway lighting increases night traffic and thereby relieves day congestion. It decreases running time and increases road capacity. It helps to bring electricity to the farm by providing a pole line. It increases real estate values by tending to extend the city along the highways and by bringing electrical conveniences. It costs one-tenth as much to light a highway as it does to replace the mud by macadam. This is not an excessive expenditure for such an obvious public improvement.

With reference to Mr. Del Vecchio's mention of shadows, it has been demonstrated that a properly designed street-lighting system is free from objectionable shadows. ROBERT P. SHAW.

Electrical Engineering Department, Massachusetts Institute of Technology, Cambridge, Mass.

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Effect of Ice on River Flow at Keokuk

FEW people realize what a disturbing influence ice can be to the flow of streams. A change of flow from 35,000 to 15,000 second-feet in less than a week's time, due merely to the formation of a thin ice cover over the Mississippi, may not seem possible at first thought, but operating records at Keokuk show that such changes are not merely possibilities but they are the regular thing. Consequently, it will be appreciated that in a hydro-electric plant such as that of Keokuk, where the entire low-water flow of the river is utilized and where only a comparatively small amount of storage is available, it is exceedingly important to predict accurately what the flow will be in order to handle the load of the system properly.

Observations over a period of ten years have shown that the winter flow at Keokuk can be predicted with considerable accuracy—in fact, with greater accuracy than is attained in prediction work during other periods of the year. The first running ice usually appears at Keokuk about December 8, and a solid ice cover forms on the river north of the plant usually in six days. From that time until about March 1, a period of eighty days, the river above the plant is completely closed. Operating experience in the last ten years has developed definite methods of estimating winter flow, which may be summed up in the following conclusions relating to the Mississippi River:

1. The flow during any winter period will depend mainly on the flow at the time of the first "freeze-up."

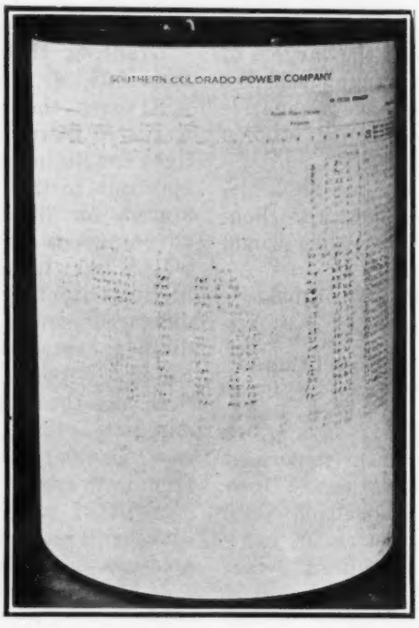
2. The initial "freeze-up" will cut the flow down to 40 per cent of the original flow in six days; it will keep it down close to that figure for five days and then allow it to recover gradually to a flow between 75 and 80 per cent of the original flow, the average period from "freeze-up" to full recovery being about twenty days.

The reason for this sudden drop in flow is that the blanket of ice holds in check the velocity of water in all streams throughout the drainage. As the underground sources continue to supply approximately normal flow, the river later rises to compensate for the lessened velocities. Hence vast quantities of water are stored up, entirely aside from that held in storage in the form of ice, thus causing the floods which invariably accompany the spring break-up.

As an aid to the observations, the river above the plant is closely watched to anticipate the formation of ice and the consequent drop in flow. Experience has shown that the flow at Keokuk begins to drop on the day following the appearance of floating ice at a station on the Mississippi 170 miles above the dam, and that the drop begins to be pronounced when floating ice is reported from Keithsburg, a station 65 miles above the dam.

During the year 1922-23 the flow at Keokuk was predicted seven weeks in advance. This was so nearly correct as to be within 1 per cent of the actual flow.

Fiber Cylinder for Holding Report Sheet



BECAUSE of the inconvenience of handling the large report sheets used for the daily station operation records and meter readings, the operators at the power plant of the Southern Colorado Power Company, Pueblo, Col., made up the cylindrical fiber holder shown in the accompanying illustration. The holder is braced with brass strips on the inside, and a handle is provided to enable the operator to carry it easily when taking the hourly meter readings. In this way the sheets are kept neat and clean and free from wrinkles.

Used Condenser Water Pumps Additional Supply

BY FREDERICK L. RAY
Superintendent of Power Plants, Union Traction Company of Indiana, Anderson, Ind.

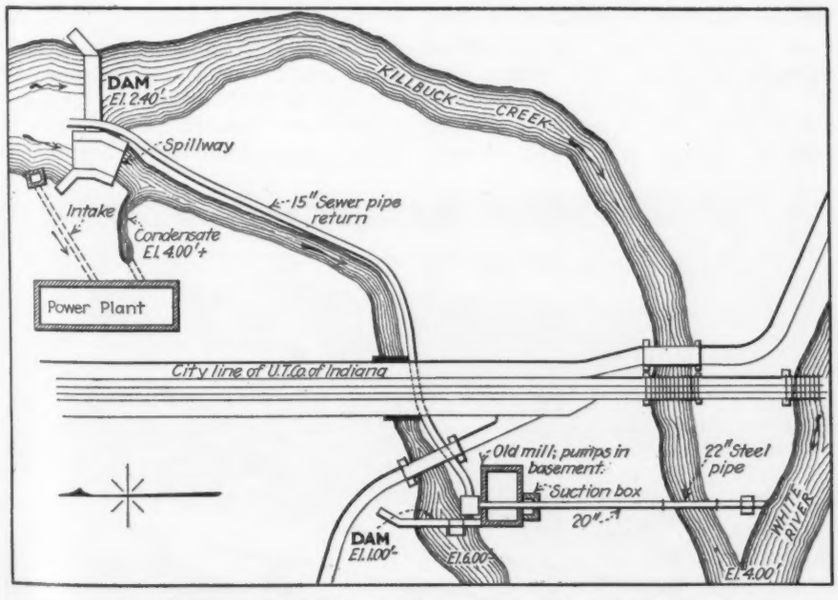
BY USING the natural fall of a condenser discharge stream to pump a much-needed additional water supply through a 15-in. tile pipe 2,000 ft. long back to the condenser intake the Union Traction Company of Indiana solved its perennial problem of providing sufficient condenser water during the summer months. The accompanying illustration shows how this additional water supply was furnished. Normally, the summer flow of the Killbuck Creek is so small that the quantity of water available is not enough for condensing purposes. The spillway of the plant runs through a millrace which had been constructed to operate a mill installation at a site 2,000 ft. below the main condenser intake. The problem before the engineering department was whether to install a spray cooling system over the intake storage or to utilize the power in the waste condensing water by placing a waterwheel at the old mill

to pump the water from the White River back to the main intake of the plant.

The latter plan was accepted by installing a pumping plant at the old mill which consists of two 2,000-gal. per minute centrifugal pumps driven by a vertical waterwheel through vertical and horizontal shafting and belting arrangements.

This water turbine was one of three others originally used to drive the mill. A few minor repairs were sufficient to place this waterwheel again in operation. A 6-ft. head at the wheel lifts the water about 11 ft., when it is discharged into a box head at the end of a 15-in. tile pipe, through which the water gravitates back to the storage intake. By this method the water used for condensing purposes is employed by its own natural drop to pump water needed to make up the shortage in Killbuck Creek.

The greatest expense in this project was the construction of the 15-in. tile underground return pipe and the 20-in. steel-tile suction pipe, 500 ft. in length, from the old mill to the White River. Fifteen men working two months completed the installation. The entire construction cost about $9,000, which includes both material and labor. Had a spray system with its pumping plant



EMPLOYING STREAM DROP IN DISCHARGE CHANNEL, WATER IS USED TO PUMP ADDITIONAL SUPPLY

been constructed at the main intake, the expenditure would have risen to approximately $20,000. Also, it was cheaper to use the energy in this stream flow than to operate the circulating pumps of the spray system.

Pilot-Wire Relays for Cables and Loops

BY O. C. TRAVER
Switchboard Engineering Department, General Electric Company, Schenectady, N. Y.

FOR the protection of cables, particularly in loop systems, pilot-wire relays are being used with good results. In all cases it is desirable to open breakers as quickly as possible to avoid the falling out of step of rotating machines, both generating and consuming, with their resulting loss of load and system surging, as well as to reduce the amount of cable destroyed. In loop systems protected by time overcurrent relays the number of stations must necessarily be limited to keep within the maximum time which, under the local conditions, is considered allowable for a severe fault to remain on the system. Fortunately, any number of additional stations can be safely cut into the loop if pilot-wire protection is used. This has the effect of making any section an independent unit in the loop and consequently not requiring the raising of any relay setting on the system. Practically instantaneous protection is provided against faults in the line between the two stations so connected, but for faults in other parts of the loop the pilot-wire relays are properly non-operative. When only one or two lines in a loop are to be provided with pilot-wire protection and the remainder are provided with time overcurrent and directional protection, the shorter sections are chosen for the pilot-wire installation simply on account of the saving in the length of pilot cable.

In the method under consideration each three-phase circuit to be protected requires three pilot wires between the two stations; two triple-pole relays, one at each station; six current transformers, one lead-film cut-out for protection at the station where the current transformers are not grounded (permanent grounding is not desirable at both ends of the pilot cable on account of possible sneak currents), and six resistors to furnish a potential for the pilot-wire circuit and incidentally to permit the use of standard types of current transformers. The connections of the apparatus are shown in Fig. 1. A study of these connections shows that there are two parallel circuits across the secondary of each current transformer. One of these consists of the restraining coil of one element of the relay in series with a resistor, and the other contains an operating coil of one relay, one pilot wire, an operating and restraining coil of the other relay and two parallel

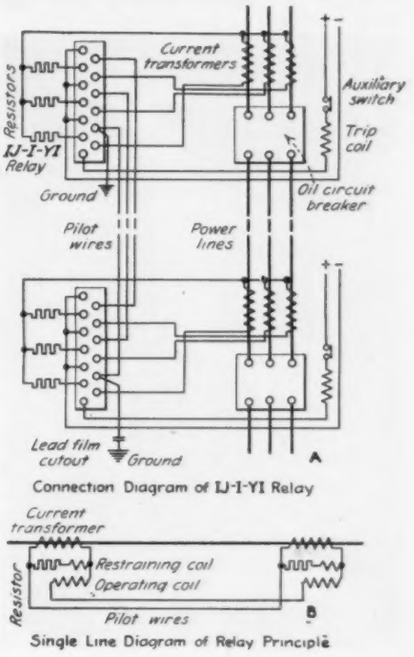


FIG. 1—PILOT-WIRE PROTECTION SYSTEM USING TYPE IJ-I-Y1 RELAYS

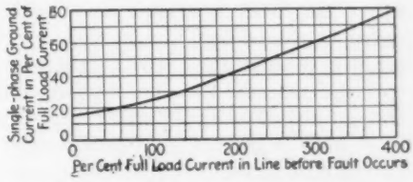


FIG. 2—GROUND FAULT REQUIRED TO OPERATE RELAY AT VARIOUS LOADS

circuits back to the current transformer, each passing through the restraining and operating coils of another element in both relays and a pilot wire.

When the corresponding line cur-

FIG. 3—INSTALLATION OF PILOT-WIRE RELAY (LEFT OF SWITCH HANDLE)

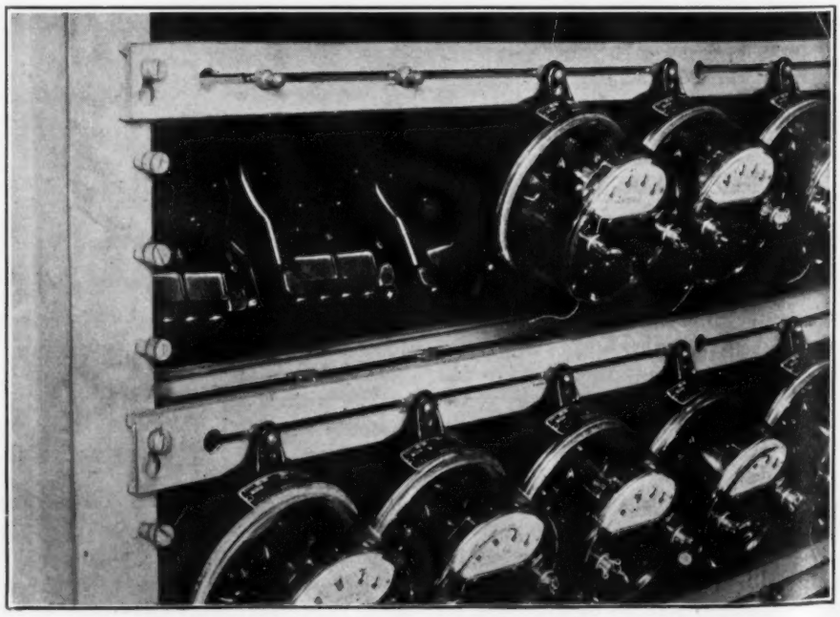
rents at both stations are equal, equal currents flow through the first circuit, consisting of the restraining coil and resistor at each station, and the potential at both ends of each pilot wire is the same. Consequently no current flows through the operating coil, regardless of the magnitude of the line current, with the exception of that due to capacity between the conductors of the pilot itself and slight probable differences in the characteristics of the various current transformers. If, however, the corresponding line currents at each station are not equal in magnitude or phase relation, different potentials are impressed on the ends of the pilot wire and a current flows which is proportional to this vectorial difference. The current flowing through an operating coil of each relay causes them to close their contacts and trip the breakers at both ends of the line when sufficient to overcome the restraint.

Each relay contains three identical elements similar to those in induction overcurrent relays. These elements contain a copper disk the rotation of which is controlled by three magnetic fields. One field is produced by permanent magnets and merely serves to steady the movement of the disk. The other two fields are produced by coils on U-shaped magnets which, by means of shaded pole pieces, produce opposed torques in the disk. One of these, called the operating coil, has a large number of turns, which carry the unbalanced current and tend to rotate the disk to close the contacts. The other or restraining magnet has three coils of few turns, one of which is connected to each phase to insure a restraint whenever needed and serving to prevent the closing of the contacts unless the balanced or operating current exceeds a certain percentage of the current being carried at the time by the main circuit. It is this feature which insures certainty against operation on through faults and at the same time permits action on very low faults in the circuit protected. Since these relays normally should operate as quickly as possible, the time lever should be at the number one position unless, for some unusual reason, a delay is desired. The time may be obtained by moving the lever toward the number ten position.

A characteristic curve, showing ground faults required to operate pilot-wire relays, is shown in Fig. 2. This curve shows the characteristics of the relay on single-phase grounds. The relay in this case was set to operate on a single-phase ground current equal to 25 per cent of the normal full-load current while full-load current was also flowing through the line. This means that the relay will operate to close its contacts on a fault in the protected section, causing a current of one-quarter the normal full-load current to flow to the ground. If there is no full load on the system, the fault current required to cause operation is less. From 200 per cent load up the ground current is approximately 20 per cent of the load. For example, at 400 per cent load, a ground current of 80 per cent of full load will cause operation. Eighty per cent of full load is 20 per cent of the four times normal load on the system. Since the troublesome secondary-capacity currents are considerably below this percentage, there remains ample margin to safeguard against the slight difference in current-transformer characteristics which may be expected at the opposite ends of the circuit.

Flexible Meter Rack

A VERY useful and convenient meter-storage rack is a feature of the new Melrose service station of the Narragansett Electric Lighting Company, Providence, R. I. The rack is assembled in unit sections composed of 2¾-in. I-beams 12 ft. high and tied together by 2-in. channels equipped with slots carrying meter-supporting buttons, as shown in the accompanying illustration. Each rack unit carries meters in rows on each side, and the over-all width of the unit from meter cover to meter cover is about 15 in. when storing 5-amp. meters. Five hundred 5-amp. meters can be stored per rack unit, the meters being about 12 in. apart vertically and hung with bases just touching. Permanent



SLOTTED CHANNELS EASILY CARRY METERS OF ONE OR MORE SIZES

bolts fastened to the I-beam uprights enable the horizontal slotted channels to be varied in separation to carry different-sized meters. About five thousands meters can be stored in a space 20 ft. long x 12 ft. wide x 12 ft. high. The rack was designed by Jenks & Ballou, Providence, R. I., engineers in charge of the construction of the Melrose station.

Overhead Distribution Construction

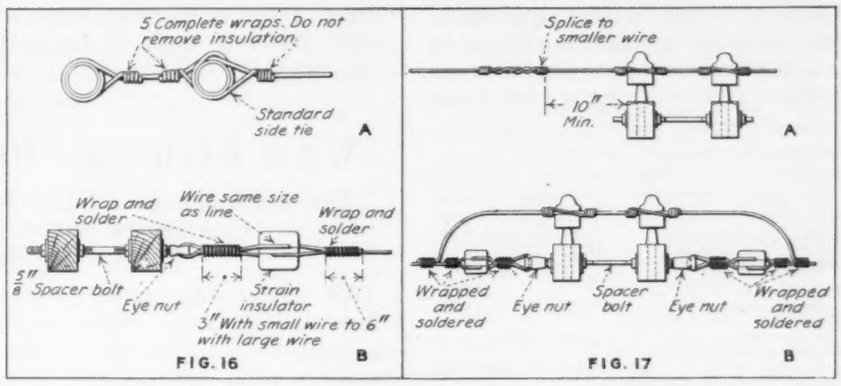
Standardized Practice as Developed and Used by the
WEST PENN POWER COMPANY, PITTSBURGH

Side Arms, Double Arms and Dead-Ends

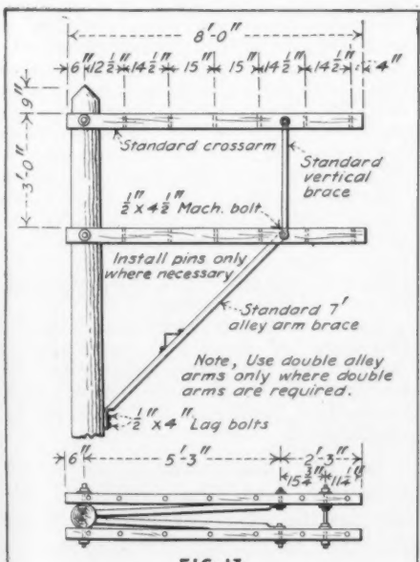
Side Arms.—In places where it is necessary to use side arms in order to avoid obstructions the type of construction shown in Figs. 13 and 14 shall be followed. The side-arm brace shall be a standard N. E. L. A. alley-arm angle brace, with forged ends, 1⅜ in. x 1⅜ in. x ⅜ in. x 7 ft., equipped with step. For double side arms two of these shall be used. Where more than one side arm is used on a pole (Fig. 13) a vertical angle brace, 1½ in. x 1½ in. x ⅜ in. x 40 in., shall be used between cross-arms. The side arm shall be made from a standard cross-arm. If the poles carry a heavy line and are side-armed for more than three consecutive spans, the unbalanced strain should be counteracted by side guying, by push braces or by crib braces as shown by Fig. 15.

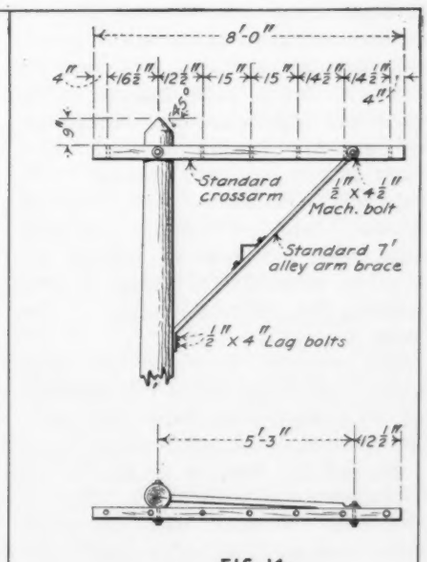
Double Arms.—Double arms shall be used at line terminals, at angles or other points where there is an excessive strain, and at points such as telephone or railroad crossings where more than ordinary safety is required. Double arms need not be used at telephone crossings with circuits of 5,000 volts or less, except when exceptionally heavy conductors or long spans are used, but should always be used for voltages greater than 5,000. Crossings spans over railroads shall be constructed in strict accordance with the prints accompanying individual work orders. Double arms shall also be used to support all installations of two or more transformers on a pole.

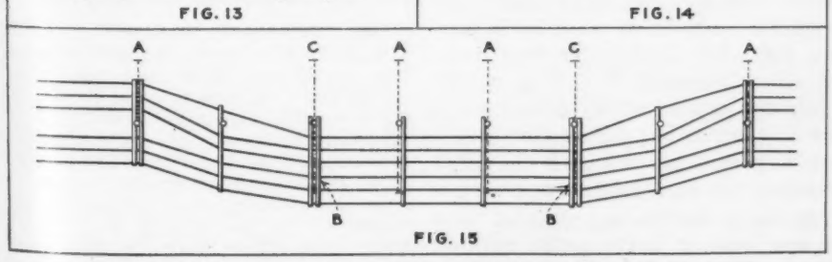
Double arms shall be made by means of double-arm or spacer bolts. These shall be installed (see Fig. 2, page 144 of the ELECTRICAL WORLD for Jan. 19, 1923) 11¼ in. from the end of the arm (half way between the end and middle pins), except that in special cases, as at transformer installations, they shall be installed as shown in the drawings for such cases. Each cross-arm should have a pair of braces, except that for double arms supporting transformers there should be no braces on the arm on which the cut-outs are mounted. Only one gain is required for double arms. This gain should be cut on the face of the pole.



FIGS. 16 AND 17—DEAD-END CONSTRUCTION AND METHOD OF CHANGING SIZE OF WIRE







FIGS. 13 TO 15—SIDE-ARM AND PART SIDE-ARM CONSTRUCTION WITH METHODS OF GUYING AND BRACING

Fig. 13—Full side-arm construction. Fig. 14—Part side-arm construction. Fig. 15—Guying and bracing side armed line. *A* is a side guy (or crib brace) to counteract unbalanced strain; *B*, the same, but for six or more wires, No. 2 or smaller; *C*, the same, for three or more wires, No. 4/0 or larger.

Dead-Ends.—In general, conductors shall be dead-ended as shown in Fig. 16. Four No. 6 wires or less may be dead-ended on pins of double arms for spans less than 150 ft., using the method shown in Fig. 16A. Heavier lines or longer spans should always be dead-ended on strain insulators as shown in Fig. 16B. Where other than four No. 6 wires are dead-ended on any arm all wires on the arm shall be dead-ended on strain insulators. Where No. 0 or heavier wire is dead-ended at spans of 200 ft. or more, and in all cases where any wire is dead-ended at spans of 300 ft. or more, two strain insulators shall be used in series in each wire.

Where the size of conductor of any circuit changes dead-ends shall be made as shown in Fig. 17. In general, solid wires which vary only one standard size may be cut straight through (Fig. 17A), using a standard splice. For other wires the conductors shall be dead-ended on strain insulators and a jumper connected to the wires as shown in Fig. 17B.

Buck Arms.—Buck arms shall be used at corners and at points where branch circuits are taken off at right angles to the main line. Buck arms shall be placed at right angles to and midway between the regular arms (see Fig. 2, page 144 of the ELECTRICAL WORLD for Jan. 19, 1923) and should be made single wherever possible in order to preserve climbing space. The use of buck arms should be kept to a minimum.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Public Utility Information and the Press

AS A MEASURE of the work of public utility information bureaus, the third annual report of the Ohio committee contains an interesting tabulation showing the extent to which newspapers have used the committee's service during the last three years. It is pointed out, of course, that the amount of space occupied in a newspaper page is not so important as is the reaction of the public. The accompanying table does indicate, however, that editors consider this information as having a definite news appeal to their readers.

TANGIBLE RESULTS OF THREE YEARS' PUBLIC UTILITY INFORMATION SERVICE

	1921	1922	1923
Number of newspapers	294	290	343
Space (column-inches)	16,584	22,958	22,342
Class of Matter	Column-Inches		
Pertaining to public utility industry generally	8,479	11,987	11,352
Regarding electric utilities exclusively	2,189	3,543	3,631
Regarding gas industry exclusively	2,022	2,616	2,680
Regarding telephone industry exclusively	1,956	2,524	2,578
Regarding electric tractions exclusively	1,938	2,288	2,106

New Divisional Organization for Providence Company

FOLLOWING its recent occupation of the new Melrose service station, which was pictured on page 1128 of the ELECTRICAL WORLD for December 1, the Narragansett Electric Lighting Company, Providence, R. I., has made changes in its operating organization under which the entire system will henceforth be handled. Effective January 1, 1924, the operation and maintenance of the system was placed under the control of two divisions, generation and distribution, each being departmentalized as required and both under the control of W. T. Oviatt, general superintendent.

The division of generation, in charge of Nicholas Stahl, superintendent, formerly general engineer of the company, will embrace direct charge of generating plant including maintenance up to the points of departure of outgoing cables and lines from transformers. The distribution division, under S. B. Swan, superintendent, formerly electrical engineer of the company, will in general embrace the activities implied in its name, including construction and maintenance of lines and substation apparatus. The garage, purchasing, and Melrose station accounting departments will continue under the general superintendent, and under him will also be a new buildings repair department.

What Elaborate Rates May Do to Bills

Three Statements, All Different in Amount, Were Rendered by a Central Station Company to a Customer for Residential Service

HOW complicated residential rate schedules may cause weird and fantastic computations of consumers' monthly bills is well illustrated in the following excerpts from a voluminous mass of correspondence between a customer and his electric service company, which has in effect two optional rates for this class of service. One is a flat charge of 15 cents per kilowatt-hour, regardless of demand or consumption. The other rate is made up of a series of consumer, demand, area, energy seasonal and minimum charges, apparently designed to include all possible elements of cost, except, perhaps, the varying phases of the moon.

The average customer in that town, when he receives his monthly bill on a post card, takes one look. The method of arriving at the total is beyond his ken, so he lets it go at that and writes a check. Not so with this customer, who has more than average curiosity and determination to know what he is paying for. His first letter was written to a personal friend, a utility executive, asking advice after receiving his initial bill for service covering a period of two and one-third months. It read in part:

MY DEAR MR. STONE—Knowing your general interest in the public utilities, would you object to giving me a little advice upon a problem which confronts me in my home, which I recently purchased at River View? I have just received a bill from the light and power company for 314 kw.-hr., $47.10, or at the rate of 15 cents per kilowatt-hour. Upon my entering a complaint, the young woman, apparently the manager, said she rather expected I would complain and that they would now send a man to measure my home, as the charge was based upon area and not upon the current consumed, and handed me a rate card. Is it possible that this company under its franchise can get away with such a raw deal on the public? By this peculiar method of computation, many of my neighbors having twice the number of lamps and other electrical contraptions pay from one-half to one-third less than I do, simply because their rooms are diminutive while mine happen to be especially large. There is also one light in an attic covering the entire third story, or an area of approximately 2,000 feet.

I am awaiting a report from the official gager of areas with some amusement to see whether the conditions he makes are so onerous as to necessitate removal of the meter and recourse to candlelight.

In due time the house was measured and the customer addressed the following letter direct to the light and power company:

GENTLEMEN — I understand from Mrs. Richardson that your official gager has visited my house and has taken the measure of each room in the dwelling in order to assess your monthly bills according to the size of said rooms, the previous bill of $47.10 for 314 kw.-hr. at 15 cents having been inaccurate.

In submitting your corrected bill please advise how this is made up in order that there may be no future misunderstanding. Also, kindly attach to the bill one of your printed cards of charges, i.e., the one reading:

60 cents per month as owner of the premises.

$1 per month because we think the service is worth that money.
$0.07 per kw.-hr. for the first 4 kw.-hr. for every 100 ft. of area in the dwelling.
$0.05 per kw.-hr. in excess of 4 kw.-hr. for every 100 ft. of area in the dwelling.
Minimum charge—500 feet of area.

The dwelling is owned by Mrs. Richardson and myself; we expect to live in it the entire year. It is not rented and is for permanent occupancy, not day by day, or month by month, for which you seem to make additional charge. I shall be obliged for this information in order to check your figures intelligently.

The foregoing letter was answered by the district superintendent of the company, who undertook to explain the various items which went to make up the minimum charge and the basis for the use of the area charge. After some three pages of discussion of such items of cost as interest, depreciation, reserve capacity and demand, the letter closes as follows:

"We feel that this three-charge rate is the most scientific rate yet devised to charge for electricity, in that it places the burden of demand where it properly belongs."

The bill as rendered, based on the area rate, amounted to $25.78. This showed a very considerable reduction as compared with the bill rendered at the 15-cent rate. But when the customer undertook to check the bill, he could not arrive at the same result by $3.53. So he indited the following epistle to the district superintendent:

DEAR SIR—I have your letter of August 22. I may be very obtuse, but, even with your explanation, it seems to me that your bill is not yet correct. According to Rate Schedule No. 1 and your letter, it seems to me your bill should be as follows:

Consumer's charge, 60 cents per month	$1.80
Demand charge, $1.03	3.09
83 kw.-hr. energy charge at 7 cents	5.81
231 kw.-hr. energy charge at 5 cents	11.55
	$22.25

The total of your bill is $25.78. On receipt of your advice, I will send check to cover.

The district superintendent's reply to this letter was encouraging at least. "Allow me to advise you in this connection," he said, "that we are both wrong, in that the consumer and demand charges amount to $1.63 per month." It looked as though they were approaching a common ground of understanding. The total bill as now figured by the company amounted to $23.20. In extenuation of the errors that had been made the district superintendent wrote: "I regret that there should have been any confusion in the matter, but when it is considered that we have some five thousand bills to get out monthly, it is not altogether surprising, with the small office force that we have, that a mistake should creep in here and there."

Suppose that every one of those five thousand customers checked his bills and found that they had been miscalculated!

The customer's reaction to this third and final bill can best be told by his letter accompanying the check in payment. He expresses an utter lack of confidence in the company's ability to compute its bills and is unconvinced of the justice of the rate basis. His letter reads:

DEAR SIR—Your letter of August 24 has been duly received, and I am inclosing herewith check for $23.20 in settlement of account to August 5. I do not believe this is correct, and I have extreme doubts as to the correctness of any of the bills issued by your company on such a complex system of computation. At your convenience will you kindly send me a memorandum showing how your company has computed the area of my dwelling and made it 2,065 ft.? As soon as I have received your statement I will have a survey made by the city surveyor and check back your figures, as it would be foolish for me to close my eyes to the tendency of irregular computation.

The foregoing is but a very small part of the correspondence exchanged. It might have been supposed, in view of its experience, that the company would have made an extra effort to render a correct bill for the next period. On the contrary, witness the following from the customer, when he received a bill for the two months' period from August 5 to October 6.

"I am sorry to trouble you once more, but I should like a little more information regarding my bill No. 745—August 5, 1922, to October 6, 1922—for 185 kw.-hr. consumed. Should the charge not be made up as follows in accordance with your letter of August 24:

Consumer's charge, 60 cents per month	$1.20
Demand charge, $1.03 per month	2.06
166 kw.-hr. (83 kw.-hr. per month) at 7 cents	12.62
19 kw.-hr. at 5 cents	0.95
	$16.83

I am sorry to be so thick at figuring this account, but after I have received a bill or two I shall be able to check back intelligently. On receipt of your advice I will send you check to cover.

The district superintendent in his reply admitted an error on the part of the company and rendered a corrected bill. He again called attention to his small office force with five thousand bills to handle, stating that "in spite of our best endeavors mistakes will occur occasionally." He closes his letter with: "I thank you very much for inviting my attention to the error, and beg to assure you that if more of our customers would check their bills a much better understanding would obtain between public utilities and their customers." It is difficult to pass this last statement over without again wondering what his meager office force would do if every one of its five thousand customers descended upon it in one month with a request for a rechecking of their bills.

However, upon receipt of this corrected bill, the customer found it necessary to address the company again as follows:

GENTLEMEN—Please send me an intelligible bill for the light service to my residence from August 9 to October 9, 1923. I have duly received your postal card No. 745, but over the figures has been placed an advertising plaster which hides them and does not state the number of kilowatt-hours on which your charge is based.

And the end is not yet. It looks as though this procedure may go on without end and as if there may be a similar tale to tell every time a bill is rendered, or until the form of rate is so simplified that it can at least be handled intelligently by the company's own bill clerks.

Central Station's Sign Aids Toaster Campaign

ONE of the most striking signs in the New England "Eat more toast" campaign, now under way, is that of the Cambridge (Mass.) Electric Light Company. The sign which

SIGN USED BY CAMBRIDGE COMPANY TO CARRY MESSAGES TO PUBLIC

is shown above faces the busiest square in the city. It contains 1,780 10-watt lamps and has been used by the company for several years to carry different outdoor messages to the public.

For More and Better LIGHT in Your Home
Watch for Our Representative!
He Brings a Message of Cheery Brightness
YOU'LL find it to your advantage to open your door and welcome our representative when he calls to introduce and demonstrate the Daylight Unit pictured above.
Let him explain the advantages of this modern lighting fixture. Ask him any questions that occur to you. He will answer them gladly and give you much information that will prove of value.
A few minutes of your time spent with our representative may be the means of making your home a better place in which to live and work—not only for this year but for many years to come. Invite him in when he calls and hear his story!
30 Days Free Trial
75c
NARRAGANSETT ELECTRIC LIGHTING COMPANY
8th Floor, Turks Head Building

NEWSPAPER ADVERTISEMENTS LIKE THIS OVERCAME SALES RESISTANCE DURING A KITCHEN LIGHTING UNIT CAMPAIGN

Advertising Opens Door to Salesmen

TO STIMULATE the sale of kitchen lighting units and to secure a better entrée into the homes visited by canvassers at Providence, R. I., the Narragansett Electric Lighting Company recently changed its entire form of newspaper advertising, breaking away from the "broadsides" furnished by manufacturers and carrying a direct message to the public written by the company's own forces. The kitchen-lighting campaign started at Providence with an experienced sales crew on January 14, and up to January 26 a total of about 1,400 units had been sold.

It was found that the broadsides did not sufficiently prepare the way for the salesmen, and extreme difficulty developed in overcoming the sales resistance encountered in a door-to-door canvass. The opposition was so strong and the results were so poor that after a few days the company inserted the advertisement here reproduced, urging the public to watch for its representative and pointing out the opportunity his coming would afford to talk over the problem of more and better light in the home.

Advertisements along this line, with small single column insertions like those shown on the four corners of the accompanying illustration of every page of a newspaper issue, have helped materially to secure interviews with "prospects," and sales are rapidly increasing. The fact that the company was offering a method of improving the lighting of the home was the means of opening the way for the salesmen which would have been closed to the average door-to-door canvasser. F. A. Gallagher, Jr., is manager of the lighting division of the Narragansett Electric Lighting Company.

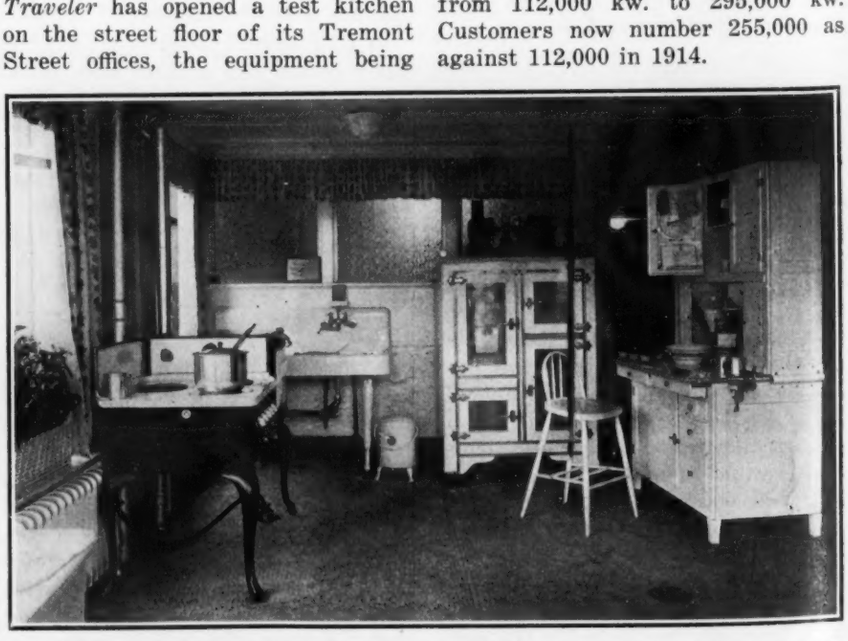
Large Electric Appliances Promoted by Newspaper

EVIDENCE of the growing voluntary demand for electrical appliances may be seen in the recent promotional work of a Boston newspaper. With the object of increasing the advertising and sale of electric household devices, particularly the larger types, the Boston *Herald-Traveler* has opened a test kitchen on the street floor of its Tremont Street offices, the equipment being electrical throughout. Local electrical supply jobbers and retailers are enthusiastic over the interest shown by the public in this kitchen, which has received a maximum of 150 woman callers a day and a daily average of sixty-five in the five days per week during which it is open. No appliances are sold, but many inquirers have been directed to local stores after seeing the operation of the electric range, refrigerator, electric water heater and other devices for home service.

Recipes are tried out upon request, and at the opening, letters of goodwill were received from Mrs. Calvin Coolidge, wife of the President, and Mrs. Channing Cox, wife of the Governor of Massachusetts, expressing their interest in the better home service organized by these papers. Several times a week articles bearing upon domestic economy appear in these papers, and the test kitchen is in charge of a domestic science instructor.

What Other Companies Are Doing

Chicago.—Appliance sales made by the Public Service Company of Northern Illinois during 1923 show an increase of more than 40 per cent over the sales of 1922, which in turn overtopped the sales of 1921 by 60 per cent. In demand the leading article was the electric flatiron, followed by table lamps, kitchen lighting outfits, washers and vacuum cleaners. From 1914 to 1923 the company's connected load increased from 112,000 kw. to 295,000 kw. Customers now number 255,000 as against 112,000 in 1914.



UNBIASED DEMONSTRATIONS OF ELECTRICAL SERVICE IN THE HOME ARE GIVEN HERE

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Photostat copies or English translations of complete articles will be furnished at cost upon request

Hydro-Electric Development and Steam Equipment

Hydro-Electric Power Developments at Shawinigan Falls, Quebec.—Developments aggregating 242,000 hp. have been completed and a 175,000-hp. project is under way by the Shawinigan Water & Power Company. Total developments will aggregate 640,000 hp., of which 400,000 hp. has been completed. The latest unit installed is a 41,000-hp. single-runner, vertical-shaft turbine to operate under 145-ft. head. Previous units installed in this plant were rated at 20,000 hp. and were of the double-runner, horizontal-shaft type. The new machine has carried a load of 49,000 hp. and is exceeded in capacity only by the Niagara Falls Power Company's new units and those installed at Queenston. The penstock is cut in solid rock, is 20 ft. in diameter inside the concrete lining and has a specially designed intake, terminating in a gathering tube. —*Power*, Jan. 22, 1924.

Davis Bridge Power Project to Develop 60,000 Hp.—The New England Power Company plans to produce 390,000,000 kw.-hr. annually on the Deerfield River in southern Vermont. Ultimately in 70 miles 1,700 ft. of head will be utilized. Besides a 200-ft. dam, the plans include a diversion tunnel to handle the river flow, a circular spillway built upstream from the dam and discharging through a tunnel and an intake tunnel to control the flow of the power tunnel, cutting off a big bend in the river and thus doubling the available head. A surge tank of unusual height causes a 90-ft. draw-down for storage use, penstocks have valve control at both ends and at the wheel inlets, and the power house will ultimately have three 20,000-hp. units with low-tension equipment placed inside the plant, a 110,000-volt transformer and switching station outside and a 66,000-volt tie-in with switching station adjacent. — *Engineering News-Record*, Jan. 24, 1924.

Generation, Control, Switching and Protection

Booster Transformers. — PROF. E. SIEGEL.—A highly theoretical treatise showing with vector diagrams the action of booster transformers under different voltage and load conditions. The subject is treated quite thoroughly.—*Elektrotechnik und Maschinenbau*, Nov. 4 and 11, 1923.

High-Power Mercury-Arc Rectifiers. —F. C. BAILEY.—The author considers the construction and operation of rectifiers and then covers the necessary auxiliary equipment, methods of placing them in service and of taking them out, parallel operation of rectifiers and rectifiers with other equipment and ends with discussion of their regulation, efficiency and power factor. The average power factor of 1,000-kw., 550-volt, 60-cycle rectifiers varies from about 95 per cent at full load to about 90 per cent at 25 per cent load.—*Power*, Jan. 22, 1924.

Skin Effect in Slot-Wound Conductors.—A. PRESS.—A theoretical discussion on the skin effect of slot-wound conductors in which Arnoldian conditions for the self-induction flux entering the conductor are taken into account.—*Electrician* (*England*), Jan. 4, 1924.

Central-Station Switching Equipment. —A description of all the switchgear necessary for the control of the alternators, meters, transformers and auxiliary circuits at the Neasden power house of the Metropolitan Railway, England. The main high-tension three-phase switchgear is designed for a potential of 11,000 volts and 33⅓ cycles and controls one 12,000-kw. turbo-alternator, five 5,000-kw. alternators and thirteen 300-amp. outgoing feeders. —*Engineer* (*England*), Jan. 18, 1924.

Transmission, Substations, and Distribution

Aluminum and Reinforced Aluminum Cables for Transportation Lines.—L. LEGROS.—The author recalls the rapid development in the use of aluminum as a conductor in the large transmission systems in Europe coincidentally with the use of higher voltages. He discusses at length the methods of calculation for conductors of aluminum-steel alloy and makes a comparison between aluminum and reinforced aluminum as to initial cost by formulas based on figures found by actual measurements. He comes to the conclusion that the price of steel in France will have to fall 40 per cent in order to make the initial cost of transmission with aluminum-steel cable equal to that of aluminum alone.—*Revue Générale de l'Electricité*, Nov. 3, 1923.

Improvements on Sphere-Head Chain Insulators.— W. WEICKER.— Although similar in outer appearance to the cap-and-pin-type chain insulator, the sphere-head type avoids cementing of the pin into the porcelain body. A small turnable ball of porcelain is provided in the upper inner part of the porcelain disk and retains the pin by means of an internally located metal nut. A lock washer has been devised which more certainly prevents unscrewing the pin. It has been further found that by pouring the head out with a special lead alloy very satisfactory results are obtained. In a mechanical testing machine such insulators withstood a pull of 6,000 kg., while breaking occurred at about 7,800 kg., which is beyond the flow point of the steel of the pin. The lead has the further advantage of insuring an unchangeable electrical capacitance of each insulator unit. In case of a standing-arc discharge along the chain of insulators which is liable to heat the units sufficiently to melt the lead, no harm will result, because the internal porcelain ball still retains the pin within the head of the disk. — *Der Elektrische Betrieb*, Dec. 24, 1923.

Units, Measurements and Instruments

Synchronous Contacting Device.—A. AHRBERG and O. SIEBER. — Certain measurements in alternating-current circuits are dependent upon the point on the current wave at which the circuit is being closed or opened. For example, when disconnecting an idle transformer the resulting overvoltage will be largest when the break is accomplished at the maximum of the magnetic field. If it is intended to study such a phenomenon with an oscillograph, no means are available for obtaining the oscillogram at the right instant. The article shows the construction and electric connection of an apparatus with which it is not only possible to choose at will any desired point on the current wave but also to maintain this point for several cycles. Essentially the device is a mechanical combination of five revolving switches, the speeds of rotation of which are in the relation of 1:0.1:0.01, the entire set being driven by a synchronous motor. By proper series and parallel connection of these five switches it is possible to select any desired time of contact making within a cycle. Samples of oscillograms taken with this contactor show its accurate function. For many alternating-current measurements this simple and small apparatus should prove a valuable addition to the oscillograph. — *Elektrotechnische Zeitschrift*, Dec. 27, 1923.

Turbo-Alternator Tests.—J. BRUCE. —Minute attention is now being given by central-station engineers to every source of loss that can be detected in the plant. This is very important and essential in obtaining a high degree of accuracy in conducting tests on equipment. The manner in which this is accomplished in the case of the large turbo-generators of the Glasgow (Scotland) Corporation is described by the author. He presents a résumé of the methods of making the principal measurements and describes the apparatus in the official and routine testing of generator units. — *Electrical Review* (*England*), Jan. 4, 1924.

Illumination

Window Design and the Measurement and Predetermination of Daylight Illumination.—P. J. and J. M. WALDRAM.—The main object of all investigations into natural illumination is to enable the designer to perform with confidence three operations which at present are done more or less by guesswork. These operations are to so design the windows that interiors are adequately lighted for their intended purposes without excessive glass area, to determine whether any existing interior is adequately lighted and to predetermine the degree to which any proposed obstruction will affect the natural lighting of a given interior. The au-

thors have developed formulas for calculating the direct daylight factor and from these formulas construct various diagrams for solving illumination problems.—*Illuminating Engineer (England)*, Vol. XVI, Nos. 4 and 5.

Motor Vehicle Lighting Regulations.—C. H. SHARP.—The committee on motor vehicle lighting in the report of the present year summarizes its activities. Specifications for rear lamps have been drawn up and adopted, receiving the indorsement of the Society of Automotive Engineers. The headlighting specifications have become a tentative American standard. The conference of motor vehicle administrators, consisting of the New England, Middle Atlantic States and Ohio, are approving headlighting devices under the standard specifications. The California headlight law embodies the standard specifications with but slight modification.—*Transactions of I. E. S.*, December, 1923.

Motors and Control

A New Method for the Development of the Theory of Commutation.—L. DREYFUS.—This is the third and last of a series of articles describing a method which the author has developed in order to investigate the commutation harmonics in single-phase series motors. The theory represents an attempt to place the commutation problem on a simple and yet correct mathematical basis. The result is a mathematical relation between the winding constants which enables the designer to predetermine the performance of a machine to a higher degree of perfection than was possible with the old theory. On the whole, the results have been well confirmed by test results. The author shows that the old conception of "the self-induction of the short-circuited coils" is not adequate; in accordance with the new theory this factor must be associated with the true distribution of the commutation field. The first application of the theory was the discussion of the commutation harmonics of the single-phase motor. The author is able to explain the existence of certain commutation harmonics which have occurred in machines with supposedly straight-line current reversals. This was possible by consideration of the potential drop under the brushes and the true form of the commutation field. The first two parts appeared Feb. 3 and Nov. 3, 1923.—*Teknisk Tidskrift (Swedish)*, *Elektroteknik*, Dec. 11, 1923.

Centrifugal Tripping Device.—H. SCHWAIGHOFER.—The usual centrifugal governor, acting directly or indirectly upon the tripping mechanism, has a gradual-action characteristic owing to which its use may not always be fully satisfactory. To prevent motors or generators gaining runaway speed, to maintain uniform speed of electric mine hoists, etc., a very exact working and absolutely dependable regulating device is required. These two properties seem to be embodied in the governor described in this article. Instead of weights suspended on levers or held together by springs, the new apparatus contains only an eccentrically lodged steel ball. When rotated this ball is pressed against a slightly inclined wall. The angle of this inclined wall is exactly determined. Not until a predetermined speed has been reached will the ball overcome that inclination, when it will suddenly roll up and against a stop. This motion will be very quick, and a considerable pressure will be exerted against the stop, which is utilized to actuate a contact for 10 amp. at 500 volts on the small model or a little oil switch for 30 amp. at 600 volts on the large type. Highest accuracy and dependability are claimed for this device.—*Siemens Zeitschrift*, December, 1923.

Electrically Operated Coal Pier.—R. W. MCNEILL.—Before building the new electrically operated coal pier of the Western Maryland Railway Company at Baltimore a very extensive investigation was carried on as to the best type of coal pier to construct. The one finally constructed utilizes electric power to the utmost as it was found that with the electrical equipment more uniform control could be obtained throughout the entire installation than could be had with steam equipment. The total rating of motors installed is 2,870 hp., all of which are 230-volt, supplied from a 1,500-kw. rotary-converter substation. The author explains the operation of the pier and a description of all of the apparatus installed.—*Central Station*, December, 1923.

Heat Applications and Material Handling

Coal-Storage Systems for Large Plants.—A review of the various systems used by large plants for handling coal. There are three systems, namely, the bridge tram, the cableway system and the ground-scraper system. The first system is ideal when an immense tonnage of coal must be handled; the second is for a smaller amount and is of less expensive construction, while the third system will handle about 50 tons per hour and its first cost will not exceed $15,000. The operating cost per ton of coal handled by the last system will average about 3 cents.—*Power*, Jan. 29, 1923.

Refractories for Electric Furnaces.—The original edition of this bulletin was a report of the proceedings of the Electric Furnace Association and included the papers presented covering this subject. The present issue differs from the original because it was thought desirable, while preserving most of the papers which were printed in the first edition, to make a number of additions with the object of bringing the book up to date. Nine papers on various refractories for electric furnace use are presented.—*Booklet of the American Electrochemical Society.*

Quality of Electric and Open-Hearth Steels.—B. E. L. DE MARE.—The three steel-making processes compared in this article are the basic electric process, the acid open-hearth and the basic open-hearth process. The object of the comparison is to explain the metallurgical conditions during the final period of each process which determine the quality of steel produced and thus show the possibilities of modifying these conditions in order to improve quality as far as possible. Measuring the quality of steel, troubles caused by impurities, oxidizing quality of slag, producing clean steel and conditions for making high-quality steel are among the details discussed in this article.—*Iron Age*, Jan. 31, 1924.

Electrophysics, Electrochemistry and Batteries

Electrolytic Meter.—An electrochemical meter is described which measures the amount of consumed energy by the amount of hydrogen gas developed on a rare-metal cathode by a shunted fraction of the metered direct current. Its accuracy and dependability are of a sufficient height to make the legalization of these meters feasible. The meters are made for capacities of 2½ amp. to 10 amp. and circuits of 110 volts or 220 volts. Assuming constant potential, their scale is graduated in kilowatt-hours and reads up to 200 kw.-hr., after which period the meter is set to zero again by simply tilting it forward. The meter has a voltage drop of 0.5 volt, and through its electrolytic cell passes a current of 0.0001 amp.—*Elektrotechnische Zeitschrift*, Jan. 3, 1924.

Traction

Railway Control Construction.—K. E. KELLENBERGER.—The annual review of the signal development in the United States for railroads shows that all classes of work are active and that the remote-control switch installations are growing in favor. Of particular interest is the itemized review of the automatic block signals and interlocking plants installed during 1923, under construction on Jan. 1, 1924, and contemplated for 1924. The tables give the name of the road, location of the signal systems or interlocking plants, miles of road affected, make, etc.—*Railway Age*, Jan. 5, 1924.

Miscellaneous

Insulating Compound.—O. FISCHER.—Description of a new liquid artificial resin which is claimed to equal, and in some respects surpass the properties of bakelite. A mixture of mineral or organic fibrous materials with a filler of chalk, slate, marble dust, etc., to which is added 15 per cent to 20 per cent of the liquid resin called "Albertol," will give results, the author asserts, which cannot be improved by any artificial resin. Using the same dry mixture to which was added in one case bakelite and in the other case "Albertol," mechanical and electrical tests were made on pieces molded with these two compounds, thus affording comparative data. The new material has, according to the author, a 50 per cent higher bending moment, is 30 per cent harder and is about equally heat-resisting. Its electric surface resistance is the same as that of bakelite when dry, but this resistance is much higher, he says, on the new compound after it has lain in water for twenty-four hours. The internal electric resistance, measured between two holes filled with mercury, is said to be higher for the new material.—*Elektrotechnische Zeitschrift*, Dec. 27, 1923.

Scientific and Industrial Research

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available and Suggestions for Co-operative Work

Conducted by PROF. VLADIMIR KARAPETOFF, *Cornell University, Ithaca, N. Y.*

[PRINTED IN THE THIRD ISSUE OF EACH MONTH]

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

Research Completed

Air Flow Through Tubes

A detailed study has been made of the changes in static pressure along a 1-in. smooth brass tube, 10 ft. long, for various quantities of air up to 20 cu.ft. per minute flowing through the tube. Special attention has been given to the changes in static pressure near the inlet and outlet of the tube. The quantity of air flowing was determined by making traverses of a second tube by means of a small pitot tube. The pressure drop has been found to vary as the 1.69th power of velocity instead of the 1.80th, as found for rough tubes. The orifice constant was found to have a value of 0.640 instead of the usual theoretical value of 0.625.—*T. S. Taylor, Westinghouse Research Laboratory, East Pittsburgh, Pa.*

Cables, Dielectric Loss in

Heretofore the greatest amount of attention has been paid to the dielectric loss at the maximum temperature, as it was this loss which limited the carrying capacity of the cable. Now that the losses are so low that the limitation in the capacity from this cause has disappeared, and with the tendency to higher voltages, the guarantees at the low temperatures are becoming of importance as it is from the measurements at the lower temperatures that the amount of ionization in the cable is determined.—*N. E. L. A. Underground Systems Committee.*

Instruments, Curve-Drawing, with Electrically Operated Chart Drive

The standard clock mechanism is replaced by an electromagnet which, when actuated by current impulses from a timing system, moves the chart ahead through a system of ratchets and gears. This enables two or more instruments to be operated in absolute synchronism from a master clock.—*Esterline-Angus Company, Indianapolis, Ind.*

Diaphragm Characteristics of a Loud Speaker

The following are among the conclusions from an analysis of pressure-frequency relations: (1) For low frequencies the sound pressure increases rapidly with increase of size of the diaphragm, while for high frequencies the sound pressure is independent of the size of the diaphragm. (2) There is a range of low frequencies over which the sound pressure is approximately independent of the frequency. This range gets narrower as the diaphragm gets larger. (3) The mass effect of the air surrounding such a diaphragm is a very important factor in determining the sound pressure.—*C. W. Hewlett, Research Laboratory, General Electric Company, Schenectady, N. Y.*

[A loud speaker built as a result of these studies was demonstrated with remarkable success at the last meeting of the American Association for the Advancement of Science in Cincinnati.—EDITOR.]

Insulators, Flashover Tests

Flashover tests were made in the Pittsfield laboratory of the General Electric Company on strings of thick porcelain insulators up to fourteen units, 22-in. ring shields being used on top and bottom. These rings kept the arc away from the disks, and cascading was limited to only one point on the string.—*Jeffrey-Dewitt Insulator Company, Kenova, W. Va.*

Ionization Currents, Measurements of

An arrangement has been developed which eliminates errors due to leakage and to other disturbing factors and permits the measurement of ionization currents to a considerable degree of accuracy. For details see *Journal Optical Society of America*, 1923, Vol. 7, page 1245.—*Roy Kegerreis, Rochester, Minn.*

[While this arrangement has been developed specifically for measuring the intensity and dosage of X-rays for medical purposes, the principles involved will be found valuable in the study of dielectrics. —EDITOR.]

Oscillating Electric Circuit, Theory of

Experiments have been performed and a theory has been suggested for the circuit consisting of resistance, inductance and capacity, with a positive potential impressed on the plate of the tube. This circuit differs from an ordinary electron-tube radio transmitter in that no arrangement is provided to vary periodically the potential of the grid. The oscillations can be accounted for by supposing that the resistance of the tube is negative and equal to the metallic resistance of the circuit at the potential at which oscillations occur. This conclusion has been verified by standard measurements on the tube. The order of magnitude of the frequency has been calculated from the constants suggested by the theory and found to be in substantial agreement with the observed frequency.—*Vincent Pagliarulo, University of Chicago.*

Radio Beacon for Navigation

Two transmitting-coil antennas are arranged at an angle of 135 deg. with respect to each other and are connected alternately to a transmitting set by means of a special switch. Waves are thus intermittently propagated directively from each coil, the intensity of the emitted wave with respect to the plane of the coils varying in accordance with a figure-of-eight characteristic. Anywhere along the bisectors of the angles formed by the two coils a receiving set will receive signals of equal intensity from the two coils. At any point not on one of these bisectors, signals from one coil will be strong and those from the other coil weak, giving an inequality in the two signals which may be readily noticed.—*Bureau of Standards, Washington, D. C.*

[A pilot was recently enabled by this method to guide his airplane into Dayton, Ohio, from a point 100 miles distant.—EDITOR.]

In Progress or Purposed

Blueprinting by Incandescent Lamps

Practical applications of light from gas-filled lamps are being made from a study of the effect of such light on blueprint paper. Several devices are being studied aiming to speed up commercial blueprinting under such illumination.—*Westinghouse Lamp Company, New York City.*

Discharge Currents

A grant has been made to Dr. P. Kapitza, working under the supervision of Sir Ernest Rutherford, to enable him to continue his work on the production of sudden and very high discharge currents and momentary intense magnetic fields.—*Department of Scientific and Industrial Research, London S. W. 1, England.*

Illumination, Heat-Absorbing Glass for

Investigations are being made to determine the characteristics of a large number of transmitting and diffusing media, looking forward to such applications as the employment of heat-absorbing glass in window spot-light projectors where the concentrated beam of heat endangers the goods on display. An extension of the same problem involves the study of the fading effect of intense lighting rays.—*Westinghouse Lamp Company, New York City.*

Physical Sciences, Division of, National Research Council

This division, through its numerous committees, has been devoting attention to the following fields: Acoustics, algebraic numbers, atomic structure, celestial mechanics, electrodynamics of moving media, luminescence, mathematic analysis of statistics, orbit theory, parallaxes, photo-electric effects, physiological optics, quantum theory, radiation in gases, research methods and technique, spectroscopy, theories of magnetism, thermo-electrical and magneto-electrical effects, vision and photo-biology, X-rays and radio activity, and X-ray spectra. Some of these fields are already of considerable practical importance; others promise to become so within the not far distant future.

Rural Lines Investigation

Together with the Farm Bureau Federation of the state, a committee of farmers has been selected to supervise tests and direct investigations on a 5-mile line, which is to be put under careful observation. Fifteen farms are to be connected, all costs are to be recorded and a careful analysis made of the revenue. The output of the farms over an extended period before and after installation of electricity will be studied and analyzed.—*Minneapolis General Electric Company.*

Suggestions for Research

Electrolysis, Research Problems

(1) Development of practical means of measuring current density across contact surfaces of pipes and earth. (2) Development of practical means of accurately determining the polarity of structures and adjacent earth. (3) Study of relation of different values of voltage drop in the track to stray current from rails. (4) Cost studies of street-railway systems and methods of power supply to determine the minimum values of track voltage drop consistent with economic operation. (5) Quantitative effect of insulating joints in protecting pipes and cables, assuming railway currents of low value. (6) Detailed study of the application and maintenance of a drainage system that will keep all underground structures negative to earth. (7) Study of joint corrosion. (8) Study of soil and galvanic corrosion in order to differentiate from the effects of stray current. (9) Setting limit of current on gas and oil pipes to avoid fire and explosion hazard. (10) Setting limit of current on power cable sheaths to avoid overheating.—*American Committee on Electrolysis.*

Machinery, Revolving, Heating of

At one of the recent meetings of the committee of the International Electrotechnical Commission a disagreement arose in regard to the temperature rise on overload. A theoretical and experimental investigation of this point is desired in order to help to obtain an international agreement based on correct facts. For a statement of the problem and an attempt at its solution see *Revue Générale de l'Electricité*, 1923, Vol. 14, pages 115 and 147.

Machinery, Polyphase, Heat Test

It is possible to furnish the no-load current to a synchronous or induction motor from one alternator and a circulating current of a different frequency from another alternator, thus obtaining full-load conditions for a heat run with comparatively little waste of power. For details see *Elektrotechnische Zeitschrift*, 1923, Vol. 39. —*E. Zachrisson, Vesteras, Sweden.*

Switch, Automatic Reclosing

In some power-distributing systems a remote village may be supplied with power through one or more transformers fed from two independent incoming lines through separate circuit breakers. For such localities an automatic reclosing switch mechanism is desired which may be operated from an automobile-type starting and lighting battery. As soon as the power is off a small direct-current motor would automatically start and drive a contact mechanism, which in turn would close alternately both primary feeds a desired number of times. If in the meantime the cause of the short circuit has been removed, the power supply would thus be restored without outside assistance.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

World Conference Plans

Delegates Will Sail on "Scythia" from New York and Boston—Many American Participants

SAILING on the new Cunard steamship *Scythia* from New York June 19 and Boston June 20, the American delegates to the World Power Conference, to be held in London on June 30 to July 12, will probably arrive at Liverpool on June 28. They will be accompanied by many members of American engineering societies who desire to attend the conference and also the summer meetings of the British engineering societies and the Kelvin centenary celebration. The number of official delegates to the World Power Conference is limited, but the privilege of attending its professional sessions is open to all members of engineering societies upon the payment of a registration fee of $10.

Thomas Cook & Son have been appointed by the British and American committees of the conference as the official transportation agents. In addition to securing the control of the *Scythia*, they are arranging for accommodations at London hotels and for a series of official tours which will be made after the conference is over. These tours will be of both scenic and technical interest and will include Great Britain, France, Switzerland, Italy and Scandinavia. Czechoslovakia is hoping to arrange a conference on scientific management and possibly technical education. The tours will have as one feature visits to power plants under the auspices of World Power Conference committees in the various countries of Europe, affording an unusual opportunity to gain entrance under the most favorable conditions to plants containing the latest developments.

American Papers

Among American delegates who are expected to prepare papers for the conference are such men as Samuel Insull, John W. Lieb, F. G. Baum, W. S. Murray and Peter Junkersfield, all fellows of the American Institute of Electrical Engineers; Owen D. Young, chairman of the board, General Electrical Company; O. C. Merrill, executive secretary Federal Power Board; Arthur P. Davis, formerly chief engineer of the Reclamation Service; John R. Freeman, D. S. Jacobus, Charles T. Main, George A. Orrok, W. M. White and H. B. Taylor.

A number of attractive events will take place in London during and immediately following the conference. American visitors will be especially interested in the reception by the American Ambassador in his new residence and the American banquet on the Fourth of July, usually held at the Cecil. The Kelvin centenary celebration commences on July 9. This will include a reception at the Royal Society and the presentation on July 11 of the Kelvin medal to an American, Dr. Elihu Thomson, probably in connection with a banquet attended by representatives of the leading engineering societies of the English-speaking world.

Public Service of New Jersey to Cut Rates

A substantial cut in electric rates is to be made by the Public Service Corporation of New Jersey, according to an announcement made by its president, Thomas N. McCarter, to the Board of Public Utility Commissioners of that state. The new rates had not been given out at the time the ELECTRICAL WORLD went to press, but it was officially stated that, based on present business, they would reduce receipts by $1,500,000 in the 202 communities affected. The corporation is also making a reduction aggregating $1,000,000 to gas consumers and continuing the experimental 5-cent trolley fare now in force.

Detroit Determines to Build 60,000-Kw. Plant

As the outcome of a conference between street-railway officials, the Public Lighting Commission and Acting Mayor Martin of Detroit, decision has been reached that the city shall start immediately to build a 60,000-kw. power plant to furnish electricity to the municipal Department of Street Railways. Together with transmission lines, substations and distribution system, the cost is estimated at $11,611,000. The decision to proceed at once with this three-unit plant will mean a saving temporarily of $2,000,000 as compared with the cost of the originally planned four-unit plant and will, if the estimate is correct, permit the plant to be built within the bond issue of $12,000,000 voted last April. It is announced that the plant will be ready to operate by October 1, 1926.

It is the opinion of the officials that the existing interim contract with the Detroit Edison Company should be canceled and a new contract be drawn in accordance with the tentative proposal reported in the ELECTRICAL WORLD for February 9, page 300, the contract to be based on a minimum sale of 110,000,000 kw.-hr. a year with the exception of the two tapering-off years. This arrangement, it is said, would save the street railways $1,250,000 between January 1, 1924, and October 1, 1926.

Priest Rapids Men Urgent

Commission Asked to Expedite License for the Huge Project on Columbia River

THE Washington Irrigation & Development Company is urging the Federal Power Commission to expedite its report on the Priest Rapids project on the Columbia River, which is being made by the district engineer of the War Department stationed at Seattle. Work, the company's representatives say, will start on this enterprise as soon as the license is granted. As previously published, it is proposed by the promoters to develop more power than is at present derived from Niagara Falls by the erection of a dam 2 miles long and 90 ft. high. The first unit is designed to develop 350,000 hp. at a total cost of $40,000,000 for dam, buildings and machinery, and the completed project will develop 750,000 hp. at a cost of $100,000,000. The plan combines power, irrigation and navigation features, and in its execution it is planned to construct an industrial city for fifty thousand workers and their families to cost approximately $12,000,000.

A satisfactory report on foundation conditions at the Pelton site on the Deschutes River, a tributary of the Columbia, has paved the way for an early development by the Columbia Valley Power Company at that point. The company a year ago received a permit to develop two sites on this river, of which the Pelton site is the lower.

An unusual situation has arisen on the power project on the Black River just north of Clifton, Ariz., where the commission had authorized the issuance of a preliminary permit to F. G. Baum of San Francisco. Dell M. Potter, a resident of Arizona, had filed a conflicting application on the project. In the opinion of the commission, Mr. Baum is in a better position to develop the power, but Arizona has chosen to grant state rights to Mr. Potter. The effect of this action is to estop Mr. Baum from undertaking the development.

Indianapolis Companies Wage Lively Legal Battle

The fight in the courts between the Terre Haute, Indianapolis & Eastern Traction Company, which seeks to do a general light and power business in Indianapolis, under the sanction of the Public Service Commission of Indiana, and the two companies now serving the city named continues to be actively waged. The Merchants' Heat & Light Company has filed a brief in the Indiana Supreme Court in opposition to admission of a third utility into the electric

power field of Indianapolis. The brief submits that the Public Service Commission in granting a certificate of convenience and necessity acted arbitrarily, without evidence and contrary to evidence. It argues that adequacy of existing service is the test of whether a new and competing utility may be admitted to any field; that the Merchants' Heat & Light Company and the Indianapolis Light & Heat Company are providing adequate service, and, furthermore, that competition under the law is limited to a "second" utility and the commission has no right to admit a third.

Three injunction suits have now been filed in the Superior Court by the traction company in its endeavor to invalidate the permission granted by the Public Service Commission to the Indiana Electric Corporation to condemn for rights-of-way for transmission lines from its new Wabash River plant near Terre Haute property crossing the leased transmission lines of the plaintiff company. The latter pleads that the law permitting the commission to exercise such power confers legislative and judicial rights upon it and is therefore in conflict with the state constitution. The Indiana Electric Corporation is controlled by the Brewer interests, which also own the Merchants' Heat & Light Company and other Indiana utilities.

Kansas to Build Experimental Rural Lines

About twenty-five representatives of farmers' organizations, central-station companies and the agricultural college met in Manhattan, Kan., on February 5 at the call of Governor Davis of that state and organized a committee on the relation of electricity to agriculture, to be carried on in connection with the national committee of which E. A. White is director. This new committee will make a careful study concerning the scope of the activities to be undertaken in Kansas, where one or more test lines like those in Minnesota will be set up under its auspices. President W. M. Jardine of the Kansas State Agricultural College at Manhattan was elected chairman of the committee.

Four A. I. E. E. Past-Presidents Get Honorary Degrees

On Wednesday afternoon, February 6, the members of the American Institute of Electrical Engineers in attendance at the midwinter convention in Philadelphia were the guests of the University of Pennsylvania at the dedication of the Moore School of Electrical Engineering. The story of the founding of this school and the appointment of Dr. Harold Pender as its dean have already been related in the ELECTRICAL WORLD (October 27, 1923, page 880).

After numerous exhibits from the research laboratories of the school had been inspected by the delegates, the dedication ceremonies were held, the principal address being made by H. T. Herr, president of the Westinghouse Machine Company. The degree of doctor of laws was conferred by the university on four past-presidents of the Institute—Edward Weston, Elihu Thomson, Frank J. Sprague and General J. J. Carty—and the degree of doctor of science on Dean Pender and Prof. R. H. Fernald, director of the department of mechanical engineering. Following the dedication ceremonies a reception was held. An educational dinner in the evening was well attended, and the educational research plans now being matured under the auspices of the Society for the Promotion of Engineering Education were outlined by William E. Wickenden, the director of the work, and others.

Swing Charges Self-Interested Opposition

Author of Colorado River Bill Alleges that Power Companies Have Joined with Owners of Mexican Land to Defeat Boulder Dam Project

HEARINGS on the Colorado River bill, now in progress at Washington before the House committee on arid lands, took an unexpected turn Wednesday, when arguments by proponents of the bill were temporarily laid aside and plans were taken up to have appear before the committee American owners of Mexican lands who might be affected, as well as representatives of power companies who might be interested in the proposed law.

This followed the presentation of the principal argument in favor of the bill by its author, Representative Swing of California, and the hearing by the committee of Secretary Hoover, chairman of the Colorado River Commission. Both of these gentlemen presented arguments previously made by them at other hearings in favor of Boulder Dam. Mr. Hoover testified that it was not economically feasible to transmit power so far as from Glen Canyon to southern California, a distance of approximately 500 miles.

It had been planned, as outlined in the ELECTRICAL WORLD last week, to devote most of the time during the present hearings to the advocates of the bill, many of whom are in Washington from California and other Western states. The change in the committee's plans came about as the result of accusations by Representative Swing that subterranean interests were in opposition to his bill. He charged that there is an offensive and defensive alliance between owners of Mexican lands and power interests, working by devious ways, to defeat his measure. Representative Baker demanded that Harry Chandler, owner of the Los Angeles *Times* and alleged by Representative Swing to be a prominent member of the Mexican landholding group, be subpœnaed, and that executives of the power companies also be summoned to testify under oath.

Dr. George L. Hoxie, a consulting engineer of the Southern California Edison Company, who was a spectator at the hearing, was asked if he had had instructions to try to defeat the Swing bill. He answered that he had not had any such instructions and stated that there were several plans for the development of the Colorado River that are more or less antagonistic and that there is a division of engineering opinion on these subjects. Dr. Hoxie testified that a strong preference for a single plan is not to be interpreted as an endeavor to influence legislation by Congress respecting any other plan.

Members of the committee desire to interrogate Mr. Chandler in regard to subjects relating to the proposed all-American canal, which is included in the Swing-Johnson bill. The committee decided that it did not have the authority to subpœna witnesses to testify under oath, but will seek such authority from the House.

SECRETARY WORK'S COMMITTEE

Prospects seem to favor an equal division of the members on Secretary Work's advisory committee. Chief Engineer Weymouth and his assistants, W. R. Young and E. B. Debler, also members of the committee, apparently will urge the approval of the Boulder Dam. Col. William Kelly, chief engineer of the Federal Power Commission; Herman Stabler of the United States Geological Survey and Colonel Crosby of the Corps of Engineers are expected to report against the dam. Some are of the opinion that the Secretary will return the bill without recommendation with the reports of these two elements composing his advisory committee.

Furnace of Cahokia Plant Used First as Dining Room

Dinner was served recently to thirty guests of the Union Electric Light & Power Company of St. Louis in one of the eight furnaces of the first section of the company's new plant at Cahokia, Ill., on the other bank of the Mississippi. Across a narrow aisle one of the furnaces at a temperature of 2,500 deg. was consuming coal at the rate of 50 tons a day, while in the "dining room" the temperature was normal.

Louis H. Egan, president of the company, in a brief address stated that the completed section of the plant represented an outlay of $11,000,000 and that $5,000,000 more would be expended on the next section this year.

Tax Exemption Amendment Is Beaten in House

A proposed amendment to the United States Constitution to abolish the tax exemption of securities failed in the House of Representatives on February 8 because it lacked the necessary two-thirds majority of the entire House. The vote stood 247 to 133 in favor of the amendment. Two hundred and ninety votes are necessary to pass a constitutional amendment, which must also have a two-thirds vote in the Senate and then be adopted by three-fourths of the states. The main objection made to the amendment, passage of which was asked by President Coolidge and Secretary Mellon, was that state rights would be invaded.

Minority Report on Muscle Shoals

Ford Offer Is Raked Fore and Aft—Violation of Water-Power Act Condemned—Southern Companies' and Other Offers Better, but Not Advocated

EMPHATIC opposition to the McKenzie bill, which authorizes acceptance of Henry Ford's offer for the government's war-time project at Muscle Shoals and which has been indorsed in the majority report of the House of Representatives' committee on military affairs, is expressed in the minority report of that committee submitted to the House by Representative Hull of Iowa and five other members of the committee. Comparing the Ford offer with that of the Southern power companies, but without specifically indorsing any of the four proposals which have been made for operation of the Muscle Shoals plants, the report declares that acceptance of the Detroit manufacturer's bid would amount "to a gift of enormous property and industrial advantage to a private citizen from the resources of the United States." The power companies' proposal, as compared with the Ford bid, it says, offers savings to the government amounting to $34,218,000 for fifty years and $75,660,000 for a hundred years.

Extracts from the minority report follow:

PROPERTY COSTING $84,000,000 FOR $5,000,000

"Mr. Ford proposes to pay $5,000,000 for the following property:

Nitrate plant No. 2, costing	$66,252,392.21
Nitrate plant No. 1, costing	12,887,941.31
Waco quarry, costing	1,302,962.88
Cash from sale of Gorgas plant	3,472,487.25
Total	$83,915,783.65

"The government, if it wants to part with the steam plant for the generation of electricity attached to Nitrate Plant No. 2, known as the Sheffield steam plant, is now offered by one of the bidders appearing before Congress in this matter the sum of $4,500,000 net cash for this unit alone.

"The gift of property is staggering, but it is not all or nearly all. No individual and no corporation in the United States has the unregulated control of 900,000 hp. or anything remotely approaching that figure. Its industrial meaning is too great to translate into figures. Mr. Ford is an industrial genius, but he has competitors. He will have none when he secures the use of this power at the cost he is to secure it, and without let or hindrance in the way he uses it. He may turn his power to whatsoever branch of industry he fancies and he will command the field. Probably no one can ever secure power again from any source at the price he proposes to pay for it. He has prospered in industry without becoming a monopolist, but he will become a monopolist of power when this grant is made, a monopolist unique in our history, for good or evil as he happens to desire."

The minority report disputes the contention of the majority that water-power rights may be no more valuable fifty years hence than they are now, which it says "defies all laws of economics."

Attention is called to twelve provisions of the water-power act, "an established policy of Congress," that would be violated or ignored if the McKenzie bill should pass. These relate to (1) comprehensive development, (2) excess profits, (3) limitation of term and recapture, (4) renewals, (5) approval of transfer, (6) maintenance and operation, (7) power for navigation facilities, (8) regulation of rates, service and security issues, (9) amortization payments, (10) headwater improvements, (11) prohibition of combinations, and (12) use for national defense.

In the event of acceptance of Mr. Ford's proposal, the minority report continues, his company would not be regulated as to rates, service or issuance of securities by either the federal government or the Public Service Commission of Alabama.

THE FERTILIZER ISSUE

Turning to the fertilizer issue, the minority report says:

"It is true that under pressure his proposal in regard to fertilizer has been altered and perhaps improved to meet exigencies resulting from its original unsatisfactory character. In our opinion the changes have been reluctantly made with the idea of enhancing the apparent attractiveness of the offer rather than with the intention of entering into a valid and binding guaranty for the production of fertilizers at Muscle Shoals by modern available methods and at lowering costs.

"At all times Mr. Ford has persistently refused to discuss the matter with the committee. In the course of the hearings just concluded the committee requested him, if he found it inconvenient to appear personally, to send accredited representatives who could discuss it on his behalf. This he peremptorily refused, meanwhile intimating to the committee that it was wasting its time. This was interesting. Claimants for government favor are frequently more patient.

"We are not convinced," the report continues, "that if given the special privileges he demands Mr. Ford could be compelled continuously to produce fertilizers at Muscle Shoals. If his plan is, and the record discloses no other, to make fertilizers by operating Nitrate Plant No. 2, he cannot do it profitably unless the evidence given by experts of learning and experience who did testify is wholly misleading. The qualifying phrases would, in our opinion, furnish the required loophole for Mr. Ford. He would 'quit,' as he has stated. He could not be compelled to resume. But he would retain the properties and advantages bestowed upon him by the government."

THE OTHER OFFERS

With regard to the alternative proposals for Muscle Shoals, the minority report says:

"Responsible parties have come forward who are willing and able to pay the government a reasonable return upon its entire investment in the power development at Muscle Shoals and also to engage in the production of fertilizers and their sale at reasonable profit. The proposals are fully set forth in the record of the recent hearings. We do not recommend the acceptance of any of the proposals referred to. They are better than the offer of Mr. Ford. If it was ever worthy of consideration that Muscle Shoals should be given to Henry Ford for the sole and only reason that no other bidder had made a comprehensive offer, that consideration has forever been obliterated. The record now discloses that if bargains are to be made a far better bargain can be made with other parties than anything Mr. Ford offers. We do not think, however, that it is proper to consider this matter from the point of view of bargaining at all. We believe that a government policy should be developed and adhered to, of which all bidders must take notice and to which they must conform.

"The properties at Muscle Shoals are required for national defense. They should not for one moment pass into the ownership of any private parties whatsoever. While it is true that all property of all citizens can be taken by the government when necessary for national defense, this furnishes no excuse for deeding away vital factors of preparedness. To allow the properties to be used under adequate supervision and without passage of title is one thing; to sell them is a totally different matter. It should not be done."

IDEA UNPARALLELED IN HISTORY

Condemning the proposition to requite Mr. Ford for the Gorgas steam plant, sold to the Alabama Power Company, the report goes on to summarize the whole Ford proposition thus:

"Imagination cannot compass the advantages to the fortunate legatee of this gigantic gift from a great government. If it shall be made, it will be unparalleled in our history. The request is to use additional government money running to $50,000,000 at a rate not half what private industry pays in the investment world; indisputable rights to nearly 1,000,000 hp. for private unrestricted, unregulated use, though millions of users may clamor for it; plant facilities, towns, streets, with all improvements, bought for a mere fraction of their cost and many millions below their ascertained value at the junk heap. Nor can imagination picture or foresee the full effect of what this will mean to the nation over the term of one hundred years and more. Can it be anything less than a sinister menace, a grave danger, an unmistakably false step wholly unjustified, a grievous wrong to the future generations that will have to live under it and abide by what we here do?"

Finally the minority of the committee fall foul of what they term the "frenzied finance" of the balance sheets drawn up to justify the Ford offer and the "strange arithmetical gymnastics" of its supporters and apologists. Four items credited to Ford, amounting in all to $100,000,000, are ridiculed as intangible in their nature or mere guesses.

Concentration of Nitrogen Industry Opposed

Opposition to the concentration at Muscle Shoals of the manufacture of atmospheric nitrogen by the electric process has been registered by the American Nitrogen Products Company of Seattle in two letters addressed to the President, the members of his Cabinet and members of both houses.

Acceptance by Congress of the Ford proposal or some similar one for the operation of the contemplated Muscle Shoals plant, it is argued, would give the grantee such a great advantage that it would be impossible to interest capital in any other air-nitrogen project lacking similar advantages. This difficulty would be equally great in the event of government operation.

Establishment of the air-nitrogen industry on a firm commercial basis would, it is suggested, be accomplished most surely and quickly by government encouragement of various promising processes in different localities rather than by concentrating such aid on one process or one plant, regardless of capacity. It is conceded that a plant at Muscle Shoals would be advantageous for the middle and eastern portion of the country, but the point is made that the Northwest is best situated by reason of its cheap water power to supply the needs of the farmers of the Pacific Coast and the greater portion of the territory west of the Mississippi, with Hawaii and the Far East as a logical export outlet.

San Francisco Mayor Signs Hetch Hetchy Ordinances

Mayor Rolph of San Francisco has signed the ordinances calling upon the California Railroad Commission to appraise the distributing systems of the Pacific Gas & Electric and Great Western power companies and providing for a bond election to supply the funds to carry on the Hetch Hetchy project and make possible municipal distribution of the city's electric power. The date of the election and the amount of the issue will remain in abeyance until City Engineer O'Shaughnessy shall have made an independent valuation of the properties of the private companies. This will later be checked against the commission's valuation. Mr. O'Shaughnessy's task may consume six months.

Carolinas to Have Utility Information Bureau

North and South Carolina public utility companies have organized the North and South Carolina Public Utility Information Bureau. Headquarters have been opened in Raleigh, N. C., and will later be opened in Columbia, S. C. The purpose of the organization, according to the announcement, is to seek through the distribution of accurate information a clearer understanding on the part of the public of the aims and problems of the utilities of the two states. More than 90 per cent of the utilities investment in the Carolinas is already represented in the bureau. The executive committee of the bureau is composed of P. A. Tillery, chairman; Stuart Cooper, vice-chairman; N. A. Cocke, R. J. Hole, Raymond Hunt, F. H. Knox and George B. Trigg. S. E. Boney, a former Philadelphia newspaper man, but a native South Carolinian, has been selected as director of the bureau, which is the thirty-first to be organized in the nation, several of them covering more than one state.

Plans of Tennessee Electric Power Company

Announcement has been made by the Tennessee Electric Power Company of its plans to spend $40,000,000 over a five-year period, to include the building of a third dam in the Ocoee district, the erection of a second steam plant at Hales Bar, the raising of the dam at Rock Island to provide for 20,000 additional horsepower and the construction of at least three new dams. The company now has under construction a 66,000-volt line from Mascot, 18 miles above Knoxville, to the town of Jefferson City, a distance of 16 miles, which will link the latter town with its high-tension transmission system. In addition to this, it has a 120,000-volt line under construction from Knoxville Coal Creek, a distance of 23 miles, to serve the coal-mining industries in that region.

"During the year 1923," a company official says "we commenced work on an addition to our hydro-electric plant at Great Falls, in middle Tennessee. This project contemplates not only the installation of an additional 22,200-hp. waterwheel, but also the raising of the dam at this location 35 ft. to increase the storage capacity of the lake. We also constructed a new 120,000-volt tower line from Cleveland to Knoxville, and our 22,000-volt lines were extended from Athens to the towns of Englewood and Tellico Plains."

Broadcasting Reaches Possible Audience of Fifty Million

The most advanced development of radio-telephone broadcasting ever accomplished occurred a week ago when a talk on radio by General John J. Carty, vice-president and chief of the research department of the Bell Telephone System, delivered before a microphone in the Congress Hotel, Chicago, was transmitted through telephone wires to stations in Providence, New York, Washington, Chicago, Oakland, San Francisco and Havana. To carry the voice of General Carty to all these points 5,141 miles of telephone wire was used, while 22,000 miles of emergency telephone lines were held in readiness between 10:30 and 11:15 p.m.

The telephone system was merely used to convey General Carty's voice to the seven radio broadcasting stations between Providence and Havana and Oakland, the receiving sets of listeners turning in with the wave lengths of the individual stations. In this way a potential audience of fifty million persons was reached.

Range Survey Topic of Commercial Section, N. E. L. A.

Definite plans were completed for conducting a comprehensive survey of the electric range load under actual operating conditions at the N. E. L. A. Commercial National Section meeting held in Cleveland last week, N. T. Wilcox presiding. This was the final meeting of all the bureaus prior to the May convention in Atlantic City, and the various committee chairmen reported on the progress already made and outlined the plans for the commercial sessions at the coming convention.

The Power Sales Bureau, V. M. F. Tallman chairman, reported the preparation of a series of authoritative studies in the electric heating field on an organized scheme of promotion, which has been prepared from the report of industrial heating schools established by the General Electric, Westinghouse and Cutler-Hammer companies.

The Lighting Sales Bureau, W. T. Blackwell chairman, read and discussed a paper which is to be presented before the convention for the purpose of impressing upon the executives of the industry the need for establishing illuminating engineering departments for all companies and the profits which await proper development in this field.

The Merchandising Sales Bureau, J. L. Harvey chairman, made its contribution for the year by an intensive study of range conditions. A three-mile street at Spokane, Wash., is going to be cut in on a special circuit and studied. This street embraces apartment buildings, city dwellings, suburban houses and farms, and will permit a definite appraisal of the range load. A comprehensive study is being made of present central-station practice and the compensation of salesmen. Much interest was displayed in the development of domestic refrigeration.

The Electric Transportation Bureau has devoted its attention this year to the promotion of four truck schools, the last of which has just now opened in New York City under the auspices of the United Electric Light & Power Company.

It was decided to make the feature of the commercial sessions of the convention this year the discussion of these important commercial problems of the industry and the presentation of addresses by a number of nationally prominent men outside of the industry who can bring to the utility men a consumer's point of view.

Society for Electrical Development's Annual Meeting

The annual meeting of the Society for Electrical Development was held at headquarters in New York on Feb. 5 and was followed by the semi-annual meeting of the board of directors. W. W. Freeman, H. D. Shute, George E. Cullinan and Paul H. Jaehnig were elected directors for a period of four years. The directors elected the following officers for 1924: President, W. W. Freeman; vice-presidents, Fred Bissell, J. Robert Crouse, George F. Morrison, J. R. Strong and J. E. Montague.

Power Companies' Reports

Revenue Statistics for 1923 Continue Good—Returns from South and Middle West

THE Consumers' Power Company has reported a balance for the year 1923 of $4,359,159, compared with $3,307,338 in 1922, an increase of $1,051,821. Operating expenses, including taxes and maintenance, were $9,108,073, compared to $7,437,074 in 1922. For December the balance was $453,407 against $347,090 in December, 1922, and operating expenses were $877,527 against $731,196.

Gross earnings of the Tennessee Electric Power Company for 1923 were $9,121,249, as compared with $7,993,197 in 1922, and net after taxes $4,178,387, an increase of $549,734 over the previous year. After deducting fixed charges, first preferred dividends and provision for depreciation, there remained a balance of $910,327 applicable to the second preferred and common stocks, or $18.21 and $3.91 a share, respectively, on the outstanding 50,000 shares of second preferred and 156,000 shares of common.

The combined statement of the Northern Ohio Electric Corporation and subsidiaries shows a balance of $101,019 in 1923, compared with $122,544 in 1922. Operating expenses, including taxes and maintenance, amounted to $7,737,409 in 1923, against $6,953,260 in 1922. December balance was $21,194, compared with $23,438 in December, 1922, and operating expenses $637,247, against $661,387.

The report of the American Light & Traction Company for 1923 shows net income of $3,909,043 after expenses, depreciation and interest, equivalent after deduction of preferred dividends to $9.97 a share earned on the $30,639,700 of common stock, against $4,052,550, or $10.86 a share on $29,445,100 of common stock, in 1922.

The Toledo Edison Company, a subsidiary of the Cities Service Company, reports the largest business in its history in 1923, when a balance of $1,132,974 for dividends was earned. After preferred dividends this was equivalent to $5.97 a share on the $13,875,000 common stock. In 1922 the balance for dividends was $542,818, equal to $3.91 a share on the common.

A preliminary statement of the North American Company and subsidiaries for the year ended December 31, 1923, shows a surplus of $15,108,312 before depreciation but after interest, taxes and preferred dividends have been deducted. This compares with $10,165,939 before depreciation in 1922. Net earnings applicable to common stock, after estimating depreciation charges on the same percentage basis as in 1922, aggregate $8,608,000, equivalent to $3.25 a share on the 2,648,000 common shares ($10 par) outstanding on December 31, 1923. This compares with a net after depreciation of $4,956,000, or $2.35 a share, on 2,109,000 shares in 1922.

The report of the Pennsylvania Water & Power Company for the past year shows a net income of $806,464, after interest, taxes and depreciation, equivalent to $8.35 a share earned on outstanding $9,769,300 capital stock. This compares with $748,046, or $8.80 a share, earned on outstanding $8,495,000 capital stock in previous year.

The Brooklyn Edison Company's annual report for 1923, the best year in the company's history, shows a net income after taxes and charges for the year of $5,714,402, equivalent to $13.07 a share on the $43,704,300 capital stock, comparing with net income of $4,105,407, or $14.46 a share on the $28,383,800 stock, in 1922.

The net earnings of the Illinois Power & Light Corporation for the twelve months ended December 31, 1923, were $9,119,047 after deducting taxes, an increase of $1,800,605 over the corresponding period of 1922. The gross earnings for the period were $27,930,854. In 1922 they were $25,064,611.

Hydro-Electric Development in Canada

Government's Report of Accomplishments in 1923 and of Projects Designed for Early Service Shows Greatest Activity in Quebec, but Other Provinces Are Busy

A REVIEW made by the Water Power Branch of the Department of the Interior of Canada indicates that about 255,000 hp. was added in 1923, bringing the total water-power installation in Canada to 3,228,000 hp. Projects actually in construction or actively in prospect will add more than 900,000 hp. Some of the principal developments completed or under way are briefly described below:

Western Provinces

The work carried on for the past two years by the British Columbia Electric Railway Company in raising its dam at the outlet of Stave Lake was completed, and plans were laid for new developments on the Stave River which will yield an additional 115,000 hp. A new unit of 25,000 hp. is to be erected this year. The East Kootenay Power Company pushed the construction of a plant on the Elk River near Elko which is to have an initial installation of 15,000 hp. and an ultimate capacity of 24,000 hp.

The initial stage of the Manitoba Power Company's development on the Winnipeg River at Great Falls was brought to completion, and two 28,000-hp. units are now in operation. Plans are under way for the addition of a third unit of similar capacity during 1924. The ultimate installation will comprise six units. The city of Winnipeg awarded a contract for three new units of 7,000 hp. each to be installed in the municipal hydro-electric station at Point du Bois on the Winnipeg River. This will bring the total capacity to 82,000 hp. with provision still remaining for two additional units.

Commission Dominates in Ontario

At the Ontario Hydro-Electric Power Commission's Queenston plant on the Niagra River two 55,000-hp. units, Nos. 5 and 6, were brought into operation. It is expected that units Nos. 7 and 8 will be installed in 1924, which will bring the station capacity to 440,000 hp. The ultimate total of 550,000 hp. to 600,000 hp. is to be reached by 1926. A new 20,000-hp. unit was installed in the Ontario Power Company plants operated by the commission at Niagara Falls, this unit replacing a similar one which was destroyed in 1921.

On the Trent River construction was commenced of two new developments, at Dams Nos. 8 and 9, of 6,600 hp. and 4,800 hp. respectively. These will serve the central Ontario system and are expected to be in operation in 1924. Operations were also commenced on two units of 12,500 hp. each in the Cameron Falls station, on the Nipigon River, to serve the Thunder Bay system.

In the mining district of northern Ontario the Northern Canada Power Company brought into operation its 8,000-hp. plant at Sturgeon Falls, on the Mattagami River, to serve the gold mines in the Porcupine area. Construction was started of a 25,000-hp. development by the Hollinger Consolidated Gold Mines, Ltd., at Island Falls, on the Abitibi River, with the expectation of delivering power at the company's mine and mill in 1924.

Much Activity in Quebec

At the Cedars plant of the Montreal Light, Heat & Power Consolidated on the St. Lawrence River, in Quebec, two units were added of 11,300 hp. each, with two further units of the same capacity to be added in 1924, which will bring the total rating to 200,000 hp. The St. Maurice Power Company achieved remarkable progress in the construction of its 120,000-hp. development at La Gabelle, on the St. Maurice River, and expects to deliver power during April. The Southern Canada Power Company awarded the contract for a 37,800-hp. development at Hemming Falls, on the St. Francis River, and construction work was placed under way. It is expected to have this plant ready for operation early in 1925.

In the Ottawa district the Ottawa River Power Company commenced the construction of a development at Calumet Falls near Bryson, Que. This plant will have an initial installation of one or two units of 22,500 hp. each and an ultimate capacity of 67,500 hp. The initial installation is to be ready for operation by January, 1925.

In the Lake St. John region the largest individual development in Quebec Province is under way at the Grand Discharge on the Saguenay River. This plant, which is being constructed for the Quebec Development Company, is to have an initial installation of 320,000 hp. The plant is expected to be

in operation early in 1926. In the same region Price Brothers & Company, Ltd., completed the installation of an 11,000-hp. development on the Chicoutimi River at Chicoutimi for use in their paper mills at Kenogami. On the south shore of the St. Lawrence the Lower St. Lawrence Power Company completed a hydro-electric installation of 3,700 hp. on the Metis River to supply the district extending from Rimouski to Matane.

In the northwestern part of the province the Northern Canada Power Company secured a lease from the Quebec government of a site on the Quinze River and immediately commenced construction. The initial installation of 20,000 hp. is expected to be completed in 1924, when the power will be transmitted for use in the gold-mining district of northern Ontario. An addition of 4,500 hp. was made to the plant of the Portneuf Hydraulic Company at St. Alban on the Ste. Anne de la Perade River.

Construction soon to begin includes a 15,000-hp. plant on the Batiscan River, a plant of 80,000 hp. at Lachine Rapids on the St. Lawrence River, a 50,000-hp. development on the Des Prairies or Back River, two projects on the Gatineau River, the first at Chelsea of 110,000 hp. and the other at Paugan Falls of 60,000 hp. to 100,000 hp.; a development on the Megiskan River, in northern Quebec, of 10,000 hp. to 20,000 hp. in connection with a pulp and paper mill, and a 21,000-hp. plant on the Du Loup River, Maskinonge County.

Of great importance to hydro-electric development in the Province of Quebec is the work of the Quebec Streams Commission. This commission has carried out valuable storage works such as the Gouin Reservoir on the St. Maurice River, the Allard Reservoir on the St. Francis River and reservoirs on the Ste. Anne de Beaupré River. It is engaged at present on a dam to cost $2,500,000 at Lake Kenogami, in the Saguenay district, which will most beneficially regulate the flow in the Chicoutimi and Au Sable Rivers to the advantage of the pulp and paper industries at Chicoutimi and Kenogami. The commission also has under way storage improvements in the basin of the Metis River at an estimated cost of $200,000.

NEW BRUNSWICK AND NOVA SCOTIA

At Aroostook Falls on the river of the same name the Maine & New Brunswick Power Company completed extensive alterations to its hydro-electric development and replaced two old units of 750 hp. capacity each by new units of 2,000 hp., thereby bringing the total capacity of the plant to 8,400 hp. A transmission line taking power from this plant is under construction, running from Bridgewater, Maine, to Woodstock, N. B.

The most notable construction work in Nova Scotia was that carried on by the Power Commission at Malay Falls, on the East River Sheet Harbor. This development, which comprises three units with a total capacity of 5,500 hp., is expected to be in operation early in 1924. Final arrangements were also made by the commission for a second development on East River Sheet Harbor to furnish power to the Albany Perforated Wrapping Paper Company of Albany, N. Y., for a pulp and paper mill at West River Sheet Harbor. This development will have an initial capacity of 6,000 hp. with provision for an increase to 9,000 hp. The Avon River Power Company practically completed a development of 2,300 hp. on the Avon River to serve the town of Windsor.

N. E. L. A. Serial Reports

In accordance with the new policy of the National Electric Light Association of issuing serial reports from its technical committees from time to time as their preparation is completed, four such sections of the report of the prime movers committee have already been printed. These serial reports are entitled respectively "The Design and Maintenance of a 1,500-Kw. Central-Station Plant," "Boiler and Turbine Room Instruments," "Stacks and Flues" and "Operating Code Manual." These serial reports will not be distributed at the coming Atlantic City convention, but will be incorporated in the 1924 *Proceedings*. The association headquarters, 29 West Thirty-ninth Street, New York, will supply a copy of the serial report first named to any member for 20 cents, of the second for 15 cents, and of the two others for 10 cents each; quantity prices on application. To non-members the prices are 30 cents, 25 cents, 15 cents and 15 cents respectively. Discussion of the reports should be sent to the chairman of the committee, Nicholas Stahl, Narragansett Electric Lighting Company, Providence, R. I.

Expansion Plan of Des Moines Electric Company

Preliminary plans for the power station to be built for the Des Moines Electric Company near the Chicago, Burlington & Quincy Railroad bridge over the Des Moines River southeast of the city have been completed, and building operations for the first two-turbine unit of the plant will probably be begun within the next thirty or sixty days. The initial expenditure of the company will, it is said, reach $6,000,000, and its expansion program involves an ultimate cost of $16,000,000.

Contracts for a 20,000-kw. turbo-generator and for the subsidiary condenser have been let to the General Electric Company and the Allis-Chalmers Manufacturing Company respectively. The finished plant, which will be built gradually as becomes necessary, will embrace five such units.

All of the engineering work for the station will be performed by the engineering department of the company at Chicago. Thomas J. Lucas, chief engineer of construction for the Illinois Power & Light Corporation, will have charge of the work.

Briefer News

Joint Engineering Meeting at Holtwood.—On Saturday, March 1, a joint meeting of the Baltimore Section, A. S. M. E., and the Philadelphia and Baltimore Sections, A. I. E. E., will be held at Holtwood, Pa. In the morning papers will be presented on the Holtwood development and equipment, and in the afternoon an inspection trip is planned.

Macon's New Power Station.—Equipment for the first unit of the new three-million-dollar steam-power plant of the Central Georgia Power Company at Macon has been ordered and will be installed and in operation by July, according to an announcement by L. A. Magraw, general manager for the company. The plant will be built on a 22-acre tract 2 miles north of the city, the site lying between the Ocmulgee River and the Southern Railway. The unit now being constructed will be rated at 8,750 kw. The plant is eventually to have five units with a total capacity of 43,750 kw. It will be owned by the Central Georgia Public Service Company, a new organization, but will be leased and operated by the Central Georgia Power Company.

Bill to Condemn Tungsten and Nitrogen Lamp Patents.—A bill has been introduced into the House of Representatives at Washington to authorize condemnation proceedings of patents necessary to the manufacture of tungsten and nitrogen lamps. Under this bill, which is sponsored by Representative Sherwood of Ohio, the government would be instructed to acquire the Just and Hanaman patent and the Langmuir patent, issued in 1912 and 1916 respectively, and make manufacture by the processes they cover free, on the payment of "reasonable" compensation to the owners of the patents.

Public Development of Great Falls of Potomac Advocated.—Major James A. O'Connor, United States district engineer, is urging the passage by Congress of the Norris and Zihlman bills, which authorize the development by the government of the water power of the Great Falls of the Potomac. Major O'Connor does not approve of a proposal to do away with the Potomac Electric Power Company if the water-power plant be built, but would instead generate the electricity at the dam and sell it to the electric company for distribution to the public. Under the project as he has studied it, he says, the present rate to the consumer could be cut in half. The proposed hydro-electric plant, according to Major O'Connor, would be capable of developing an average horsepower of 120,000 throughout the year, whereas only about 60,000 hp. is used now by the electric company in lighting Washington. There would be enough power to light Washington and provide power and light for factories employing 150,000 men.

A Forty-Thousand-Dollar Electric Sign.—The sign shown here, erected across the front of the Putnam Building, reaching from Forty-third to Forty-fourth Street on Broadway, New York, was erected at a cost of $40,000 by the Famous Players-Lasky Corporation to advertise a motion picture playing across the street. It burns

235 kw. per hour and was designed by Harold B. Franklin and executed by the Norden Company, Inc. No electric bulbs are visible anywhere in this sign, which lights up and fades out by a system of indirect and diffused lighting.

Youghiogheny Development Going Ahead.—Permission has been asked from the Public Service Commission of Maryland for the consolidation of the Youghiogheny Hydro-Electric Company, the Youghiogheny Power Company and the Youghiogheny Water & Electric Power Company into one company under the name first given. The combined company, which will have $13,000,000 of capital stock, is to develop the water power of the Youghiogheny and its tributaries in Garrett County, Md., constructing four dams and three power stations. The dams are to be at Sang Run, Swallow Falls, Deep Creek and Crellin, the last-named being for storage only. At Deep Creek a maximum head of 437 ft. will be available. The ultimate capacity of the three plants will be more than 100,000 hp. Work is under way.

Radio Broadcasting for the Schools.—An innovation in New York City schools is to be made on February 18, when the Board of Education will, with the co-operation of the Radio Corporation of America, begin the transmission of daily educational programs. The programs are designed primarily to acquaint the people with the work of the schools. Superintendents will explain exactly what is done in their respective departments and to what purpose. Pupils will take part in the later programs with regular recitations, music lessons, glee club and school orchestra concerts, spelling bees and special exercises for holidays.

"White-Way" Lights for St. Louis Suburbs.—The Delmar Boulevard Improvement Association of University City, Mo., has just signed a five-year contract with the Union Electric Light & Power Company of St. Louis for the "white-way" lighting of Delmar Boulevard from Skinker Road in St. Louis to Harvard Avenue in University City. There will be sixty-four lamps installed, forty-eight of which will be maintained by the property owners and merchants and sixteen by University City. The lights will be installed every 90 ft., facing each other, on brackets on the poles of the United Railways. These lamps will be 400 cp. each and will burn all night. They will be ready by March 15.

Cost of New York State's Developments Exceeds Estimates.—The work of constructing the two state power buildings at Crescent Dam and Vischer Ferry on the canalized Mohawk River in New York is progressing, and the Commissioner of Canals says that generating machinery will be installed in the spring or summer but that he does not expect either of the plants to be ready to produce power before the spring of 1925. The state proposes to generate electric power at these two dams under a law passed in 1922 for sale to private companies. The estimated cost of the Crescent Dam project when the law was passed in 1922 was $1,064,965 and of the one at Vischer Ferry $1,119,415. These totals, it is said, will be exceeded by perhaps $500,000, or nearly 25 per cent, before the work has been completed. The gross head at the Crescent Dam is 27 ft. and engineers estimate that 8,000 hp. will be available 60 per cent of the time. The Vischer Ferry project, it is estimated, will generate from 8,000 hp. to 16,000 hp. The power at both plants will be intermittent.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations is published in the first issue of each volume. See January 5 issue, page 72, for latest list.]

New Mexico Public Utilities Association—Franciscan Hotel, Albuquerque, Feb. 18-20. C. E. Twogood, Albuquerque, N. M.

American Institute of Mining and Metallurgical Engineers—New York, Feb. 18-21.

American Physical Society—New York, Feb. 23.

Oklahoma Utilities Association—Huckins Hotel, Oklahoma City, March 11-13. E. F. McKay, First National Bank Bldg., Oklahoma City.

Association of Electragists, Eastern Division—McAlpin Hotel, New York.

Illinois State Electric Association—Hotel Sherman, Springfield, Ill., March 26-27. R. V. Prather, Springfield, Ill.

American Institute of Electrical Engineers—Spring convention, Birmingham, Ala., April 7-11. F. L. Hutchinson, 33 West 39th St., New York.

Wisconsin Utilities Association—Hotel Pfister, Milwaukee, April 17-18. John N. Cadby, 445 Washington Bldg., Madison.

Southwestern Division, N. E. L. A.—New Orleans, April 22-25. S. J. Ballinger, San Antonio, Tex.

Southwestern Public Service Association—New Orleans, April 22-25. E. N. Willis, Dallas, Tex.

American Electrochemical Society—Hotel Bellevue-Stratford, Philadelphia, April 24-26. C. G. Fink, Columbia University, New York.

Nebraska Section, N. E. L. A.—Omaha, May 8-9. H. M. Davis, Bankers' Life Bldg., Lincoln.

National Electric Light Association—Atlantic City, N. J., May 19-23. M. H. Aylesworth, 29 West 39th St., New York.

Electric Power Club—Seaview Golf Club, Absecon, N. J., May 26-29.

Potential Development of Flathead River Is 90,000 Hp.—The recent reconnaissance of the South Fork of the Flathead River, Montana, made by an engineer of the Geological Survey resulted in finding a site where a dam 350 ft. high would create a reservoir having a capacity of 1,320,000 acre-feet. A mean effective head of 280 ft. could be obtained at the reservoir, which would make potentially available more than 90,000 hp. A copy of the engineer's report will on request be sent by the Geological Survey to the office of the district engineer nearest the applicant, where it may be consulted.

New 30,000-Kw. Unit for Joliet.—The generating capacity of the Joliet station of the Public Service Company of Northern Illinois has been increased to 50,000 kw. by the installation of a 30,000-kw. turbo-generator of General Electric make which was placed in the line January 23. Additional power equipment installed to operate this turbine includes four new boilers rated at 1,400 hp., one 52,000-sq.ft. surface condenser, two circulating pumps rated at 300 hp. each, two hot-well pumps of 100 hp. and a coal-handling system consisting of a 700-ft. belt conveyor together with a track hopper and breaker. The additional generating capacity provided by this unit will be connected to the company's transmission system through various lines emanating from Joliet. A new 33,000-volt pole line was constructed last fall between Joliet and Maywood. With this line there are now five main trunk 33,000-volt transmission lines connecting the Joliet station with the other parts of this company's system.

Merger in Arkansas.—The electric light and power companies at Fayetteville, Springdale and Rogers, Ark., have been consolidated and are now known as the Northwest Arkansas Utilities Company. E. C. Smith of New York is president of the company. Power lines are being run to nearby towns and equipment enlarged. V. McDaniel, who was with the Fayetteville Gas & Electric Company before the merger, is local manager of the expanded company.

Wisconsin Public Service Corporation to Spend $3,000,000.—Approximately $3,000,000 will be expended during 1924 by the Wisconsin Public Service Corporation in carrying out an improvement and expansion program, according to an announcement made by Vice-president C. R. Phenicie. This program includes additions to its electric light and power, street and interurban electric railway and gas systems throughout the northeastern part of Wisconsin and in Menominee, Mich. A considerable part of the outlay will be used for the development of water power in Marinette County, Wis., to provide a reserve for Menominee and Marinette.

Two Central-Station Companies to Increase Capital Stock.—The Brooklyn Edison Company has applied to the Public Service Commission for permission to issue $15,000,000 additional common stock, which will be offered to shareholders at par. The sale of this new stock will increase the company's outstanding capitalization to $58,382,000. A certificate has been filed in the office of the Secretary of State at Albany, N. Y., increasing the capital stock of the Detroit Edison Company from $60,000,000 to $85,000,000.

Power Loop Is Completed at Davenport, Iowa.—An electric power loop at Davenport, Iowa, one of the important 1923 construction projects of the United Light & Power Company, has been completed. The new power line, which cost about $75,000, crosses the Mississippi River on the Crescent Bridge, bringing into Iowa a 13,200-volt line planned to prevent power interruptions. Until the completion of this project that section of Iowa had only one artery of electric power, that over the government bridge, which was composed of two 13,200-volt lines The possibility of a break in this circuit was constant, and such breaks did occur at various times in the past, throwing Davenport into darkness and interrupting the power supply at various times. The new line is 3 miles long. Leaving the central station in Moline, it is carried down the Illinois shore past the government bridge, where the old lines cross, to the Crescent Bridge and across this into Davenport. For part of the distance the line is carried on steel towers and the remainder of the way underground.

Wallenpaupack Creek Development.—The Pennsylvania Power & Light Company has received a permit from the state authorities to construct a large impounding dam for the hydro-electric development project at Wallenpaupack Creek, between Pike and Wayne Counties, over which the Federal Power Commission has also taken jurisdiction. The plant will be constructed at Wilsonville, Paupack Falls, and as previously stated (see ELECTRICAL WORLD, July 28, 1923, page 199), will be connected with the company's other plants in that part of Pennsylvania. Two 26,800-hp. units will be installed. The dam will be 60 ft. high and 1,150 ft. long and the reservoir will cover 5,760 acres. It will, it is said, be the largest dam in the state. This plant will be operated by the Paupack Power & Light Company of Allentown, a merger of thirty-two small concerns.

Oklahoma Utilities Association.—The sixth annual convention of this association will be held at the Huckins Hotel, Oklahoma City, March 11, 12 and 13. The electric light and other divisions will each hold sectional meetings, supplemented by round-table discussions. The manager of the association, E. F. McKay, is sending out general questions, "What problem is causing you the most trouble?" and "Have you been able to solve some vexing public utility problem?" with the request for suggestions. W. J. Canada of the N. E. L. A. will address the convention on "Coordination of Utility Facilities, Rights and Duties."

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

Thomas A. Edison was the guest of honor at the annual birthday reunion of the Edison Pioneers held on Monday, February 11, in the ballroom of the Robert Treat Hotel in Newark, N. J., to celebrate his seventy-seventh birthday. Many of the men who assembled worked directly under Mr. Edison as boys during the laboratory days at Menlo Park and many of them are leaders today in the electrical industry. John W. Lieb, vice-president of the New York Edison Company, announced at the dinner that plans had been adopted for the erection of a permanent Edison memorial in West Orange, and it was voted to carry them into effect in conjunction with the New Jersey Historical Society.

Robert W. Curran, formerly superintendent of the St. Joseph (Mo.) Railway, Light, Heat & Power Company, has been appointed general superintendent of the Ohio Public Service Company at Portsmouth, Ohio. Both these properties are subsidiaries of the Cities Service Company.

T. A. Burdick, formerly power engineer with the Fairfield Paper Company, Baltimore, Ohio, has joined the Columbus (Ohio) Railway, Power & Light Company in the capacity of designing engineer.

R. Z. Zimmermann, who has been local manager at Zanesville for the Columbus, Newark & Zanesville Electric Railway Company, has been made general manager of the company, with headquarters at Zanesville. Previous to his association with the Zanesville company Mr. Zimmermann was manager of the Salem (Ohio) Lighting Company.

B. Morris Hooper, formerly with the engineering organization of H. M. Haven & A. T. Hopkins, Inc., Boston, in appraisal work and industrial plant design and construction, has joined the division of construction and engineering of Stone & Webster, Inc., Boston.

John W. F. Bennett has become associated with Stevens & Wood, Inc., who do an engineering, financing, construction and management business, as vice-president and contract manager. Mr. Bennett was formerly chief construction engineer of the American Sugar Refining Company.

George A. Lajoie has resigned his position with the Southern Canada Power Company, Montreal, to join the electrical commission of the city of Montreal.

Eugene L. Fallon, formerly assistant electrical superintendent for the Aluminum Company of America at Niagara Falls, is now engineer in the electrical division of Stone & Webster, Inc., Boston.

S. S. Howell has returned to the consulting mechanical and electrical engineering field after serving for the past nine years as chief engineer with the United Chemical & Organic Products Company and the Central Chemical Company of Hammond, Ind. Mr. Howell, while being retained as advisory engineer to the above companies, will devote his entire time to the development of ideas and methods involving special applications of mechanical and electrical engineering experience.

General Gustave Ferrié, at the head of the French government wireless services, was awarded the Kuhlmann foundation gold medal given annually in France through the intermediary of the Société Industrielle du Nord. General Ferrié has been identified with wireless telegraphy since 1899 and has written voluminously on radio telegraphy and kindred subjects.

Charles R. Huntley was recently re-elected to the presidency of the Buffalo General Electric Company. Mr. Huntley is entering upon his seventeenth consecutive term as chief executive officer of the Buffalo company.

C. H. Berry has been appointed technical engineer of power plants of the Detroit Edison Company, to succeed P. W. Thompson, who, since his appointment as chief assistant engineer of power plants, has temporarily fulfilled the duties of both positions. Mr. Berry will be technical assistant to the chief and chief assistant engineer of power plants and will in particular have direction of plant operating studies, experiments, routine tests and cost analyses.

H. L. Harris, auditor for the past six years of the Twin State Gas & Electric Company, a New England subsidiary of the Middle West Utilities Company, has recently been placed in charge of the sale of securities and public relations work of the Twin State company.

Gerard H. Matthes, for the past three years United States assistant engineer in charge of the water-power survey of the Tennessee River for the War Department, with headquarters at Chattanooga, Tenn., has resigned in order to devote his entire time to consulting work in aërial photographic mapping. He has recently been retained in a consulting capacity by the Fairchild Aërial Camera Corporation of New York City in order to assist in developing its aërial mapping department with special reference to the production of such maps of hydro-electric and other engineering projects. Mr. Matthes will remove to New York.

William H. Thomson, Jr., has been appointed assistant general manager of the Texas Power & Light Company, succeeding W. G. Schmauder, who has gone to Cuba. Mr. Thomson has been associated with the company since 1920, when he entered its ranks as efficiency engineer, and has been identified with the electrical industry since his graduation from Cornell University in 1898. During this period he has served in

executive positions with many electrical properties in the West and Middle West, including the Union Light, Heat & Power Company, Fargo, N. D.; San Antonio Gas & Electric Company, Illinois Traction System, Des Moines Electric Company and the Kansas City Light & Power Company.

William J. Wallace, president of the Eck Dynamo & Motor Company of Belleville, N. J., was named by the commonwealth land party, formerly known as the single tax party, as its candidate for president. The nomination took place at the closing session of the annual convention of the party held in New York City on Saturday, February 9.

J. C. Lincoln, president of the Lincoln Electric Company of Cleveland, was named as vice-presidential candidate by the commonwealth land party, which was formerly known as the single tax party.

Philip M. Wentworth, formerly assistant manager of the Truckee River Power Company, Reno, Nev., has been appointed manager of the Fort Madison (Iowa) Electric Company.

John S. Bleecker, general manager of the Columbus, Newark & Zanesville Electric Railway Company, Zanesville, Ohio, is severing his connection with the company to enter the management department of Day & Zimmermann, Inc., with headquarters in Philadelphia. The Zanesville company is under the management of Day & Zimmermann.

J. H. Walker has been assigned to the general manager's staff of the Detroit Edison Company as assistant engineer, to succeed C. H. Berry, recently appointed technical engineer of power plants. Mr. Walker will retain the title of superintendent of central heating and will continue to be responsible for that department in addition to his new duties.

Walter H. Burke, who has been manager of the Keokuk (Iowa) Electric Company, has been appointed manager of the Houghton County (Mich.) Electric Light Company and the Houghton County Traction Company. Before becoming manager at Keokuk in the spring of 1923 Mr. Burke had been in charge of matters pertaining to the Southwestern group of properties under Stone & Webster management.

H. M. Pauley, who has been connected for five years with the Wisconsin Gas & Electric Company as superintendent of the electric light and power distribution systems at Racine, has been made manager of the company's properties at Kenosha, succeeding Orman Koenes, recently transferred to Waukesha. Mr. Pauley joined the electric distribution department of the Milwaukee Electric Railway & Light Company about ten years ago and subsequently was sent to Racine. The Wisconsin Gas & Electric Company is a subsidiary of the Milwaukee company.

William Johnston, Jr., has been appointed auditor of the Twin State Gas & Electric Company, a New England subsidiary of the Middle West Utilities Company.

John J. Noell, formerly with the Electrical Company, Wilmington, Del., has been appointed engineer in the electrical division of Stone & Webster, Inc., Boston.

S. E. Uncapher and **O. B. Rinehart** have been appointed assistants to A. J. Francis, manager of fractional-horsepower motor sales at the General Electric Company's plant in Fort Wayne, Ind., according to a recent announcement. These appointments followed the recent resignation of S. P. Hirsch as assistant manager of this department.

Wilfred J. Kerns, formerly connected with the Merchants' Dispatch Company, East Rochester, N. Y., is now in charge of the Rochester Gas & Electric Corporation's branch office at East Rochester.

Edward B. Elliott, formerly power engineer for the Solvay Process Company, Syracuse, N. Y., is now engineer in the mechanical division of Stone & Webster, Inc., Boston, Mass.

R. W. Reddy, formerly of the sales staff of the George H. Wahn Company, electrical supply jobber, Boston, has been appointed credit manager of the company.

Frank E. Maize, heretofore manager of the Electrical Bureau of the city of Philadelphia, has been appointed chief of the department to succeed James F. McLaughlin, who resigned last November on account of ill health. Mr. Maize, who has been in the employ of the city for the past thirty-five years, was made assistant manager of the bureau in 1910 and advanced to the position of manager in 1921.

George F. Marsteller, formerly electrical designer with the Utica Gas & Electric Company, has affiliated himself with Stone & Webster, Inc., Boston.

Dan Beard, treasurer and auditor of the Fort Smith (Ark.) Light & Traction Company for the past three years, has been appointed supervising auditor of the Northern States Power Company for North and South Dakota. Mr. Beard has been with the Byllesby organization for fourteen years.

John J. Koetzle, formerly associated with the Westinghouse Electric & Manufacturing Company, is now connected with the Philadelphia Electric Company.

Lawrence D. Kingsland, 2d, has been appointed engineer in the hydraulic division of Stone & Webster, Inc., Boston. Mr. Kingsland was formerly with the Foundation Company, engaged in water-supply work at Lima, Peru.

A. R. Schiller, who was previously associated with John A. Stevens of Lowell, Mass., is now connected with the Manchester (N. H.) Traction, Light & Power Company.

Ferris N. Wheeler, who has been in the electric meter department of the Oklahoma Gas & Electric Company at Muskogee, has been transferred to the Oklahoma General Power Company, Oklahoma City.

A. H. MacAdam, formerly superintendent of construction for E. L. Phillips & Company, engineers, New York, is now connected with the New York office of the Electrical Engineers' Equipment Company as sales engineer.

P. D. Lawrence, formerly superintendent of power with the Hortonia Power Company, Brandon, Vt., and also with the Port Henry (N. Y.) Light, Heat & Power Company, which is controlled by the former company, is now connected with the Lowell (Mass.) Electric Light Corporation as power salesman.

W. E. Prosser, for the past two years manager of the merchandising department of the Adirondack Power & Light Corporation, Schenectady, N. Y., has severed his connection with the company to affiliate himself with the Robertson-Cataract Company at Syracuse.

Henry C. Saben, assistant purchasing agent of Charles H. Tenney & Company, Boston, has been appointed purchasing agent for committees in connection with the ninth annual international convention of purchasing agents, to be held at Boston during the week of May 19.

George F. Shirley, formerly in the sales department of the D. & W. Fuse Works of the General Electric Company, Providence, R. I., has been made sales representative at large for the Chase-Shawmut Company, fuse manufacturer, with headquarters at the factory, Newburyport, Mass.

Herbert William Young, president of the Delta-Star Electric Company, Chicago, arrived in New York on February 13, after spending several months abroad. Mr. Young read a paper at the Paris international conference on long high-voltage power lines and later visited manufacturing establishments and light and power companies in all parts of Europe.

General Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, arrived in New York on Wednesday of this week on board the *Berengaria*, after visiting Japan, China, India, France and England. While in the Orient General Tripp completed arrangements with the Mitsubishi Company of Tokio for the organization of a company at Nogoya with $7,500,000 capital. In this project the Westinghouse company has a substantial interest. He expressed astonishment at the electrical development in Japan, stating that the Japanese are abreast of the United States in the development of their water power and that they are making great advancement in the use of small power motors for industry.

Obituary

William E. Holcombe, for twenty-eight years connected with the General Electric Company in the capacity of designing engineer, died recently at his home in Schenectady, N. Y. After being graduated from Lehigh University, Mr. Holcombe entered the drafting department of the General Electric Company, where he was intimately associated with the early development of the alternating-current generating apparatus. In 1908 he was placed in charge of a section devoted to the design of alterations, which position he held until the time of his death.

Commission Rulings

Proper Construction Ordered on Diminutive Hydro-Electric System.—The Public Service Commission of Oregon has told the Paisley Electric Company, which serves about eighty customers by means of a small turbine connected to a 25-kw. generator, that it must reconstruct its plant so as to do away with interruptions to service caused by slush ice freezing on the waterwheel and so as to raise its distribution lines to the minimum height of 18 ft. prescribed by the National Electrical Safety Code for street crossings.

Burden of Justifying Unusual Operating Expense Is on Utility.—The North Dakota Board of Railroad Commissioners, in rate proceedings affecting the Northern States Power Company and its North Minot plant, said that while the commission has power to inquire into the efficiency of management of public utilities, the judgment of the commission must not be substituted for the judgment of the owners of the property, unless there is evidence of bad faith or an abuse of discretion. Where an operating expense is an unusual one the utility should assume the burden of proving the reasonableness of such charge. Operating revenues and expenses must, the commission remarked, necessarily be an estimate based upon past experience and with consideration given to changed operating conditions prevailing at the time of the inquiry and changes which may be anticipated.

Uniformity of Rates Dependent on Uniformity of Conditions.—In granting to the Southern Power Company the 10 per cent increase of rates already recorded (ELECTRICAL WORLD, January 19, page 153), the North Carolina Corporation Commission said in answer to a comparison instituted between the rates of the Southern Power Company and those of the Georgia Railway & Power Company and the Alabama Power Company: "The rates of these companies are not stated in terms that are comparable. The rates of the Southern Power Company are simply stated and easily understood. The rates of the Georgia company are complicated with an element of maximum demand. . . . Rates must be determined by uniform rules, but there can justly be uniformity of rates only when there is uniformity of conditions under which service is rendered. The service of the Southern Power Company is materially different from that of the Georgia or the Alabama company. The Southern's power is developed in widely scattered units and is distributed over wider areas to find its market. North Carolina has not large cities to furnish concentrated fields of consumption like Atlanta and Birmingham. A large part of the Southern's total investment is in its extensive distribution system, which reaches twenty-three counties in North Carolina and a considerable part of South Carolina. The wider the distribution of electric current the more expensive it necessarily becomes. This results not only from the higher capital investment in the distribution system, but also from the line lossage of power, which increases with increasing distance of transmission. The Southern has 1,585 miles of high-voltage steel tower transmission lines in its system, of which 919 miles are in North Carolina, and 223 miles in South Carolina are used in transporting power to North Carolina lines. Another element of increasing importance in hydro-electric service is the cost for coal-equalizing service in marketing the year round the equivalent of the maximum efficiency of the hydro-electric plants, and the Georgia and Alabama companies are nearer the coal fields than is the Southern. Under these varying conditions the rates of one company could not be justly used to measure the return which investment in the other is entitled to earn."

Recent Court Decisions

Federal Income and Excess Profits Charges.—The West Virginia Supreme Court of Appeals, in a suit affecting natural-gas charges which was brought by Charleston and other cities against the Public Service Commission of the state, decreed that, under the decision of the Supreme Court of the United States in Georgia Railway & Power Company vs. Georgia Railroad Commission, which declared, "The disallowance of the federal corporate income tax as an operating expense of a public utility company is erroneous," the West Virginia commission rightly permitted this tax to be so charged, but that federal corporate excess profits taxes of a public utility should be paid by the corporation, not by its patrons, and are not chargeable to operating expense in a rate case. (120 S. E. 398.)*

Duty of Municipality to Inspect Its Plant.—A municipal corporation maintaining an electric distributing plant owes to the public the duty of so inspecting and maintaining the same as to prevent change and deterioration from natural causes resulting in a dangerous condition. Where injury occurs because of a defect which could have been prevented by inspection, and there is a total failure to inspect for seventeen months, the municipal corporation is negligent and liable accordingly. So holding in Goar vs. Village of Stephen and Minnesota Electric Distributing Company, the Supreme Court of Minnesota affirmed so far as regarded the village a verdict for the plaintiff, who was injured by high-voltage electricity escaping from conductors into her home. The Supreme Court, however, reversed the verdict as it affected the company, which generated the energy that the municipality distributed and, as an independent contractor, had reconstructed the system. The court was of opinion that the original clearance provided by the company between conductors was sufficient to insue safety, and that for its reduction from at least two inches to the danger point the village was responsible through its lack of inspection. (196 N. W. 171.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Electric Signs as Nuisances.—In The Shelburne, Inc., vs. Crossan Corporation, the Court of Chancery of New Jersey granted a decree to an Atlantic City hotel against the operation of an electric sign carrying 75-watt and 100-watt lamps, which were alleged to injure the plaintiff's business by disturbing patrons into whose rooms the reflection was cast. The court, however, limited the prohibition to the hours following midnight, proof being given that the hotel orchestra played and dancing was indulged in up to that hour. (122 At. 749.)

Duty of Company to Inspect Wires After Storm.—Declaring that after a storm of considerable vigor, although not of extraordinary violence, the owner of an electric light plant is bound to anticipate that its system may be out of order and is required to make a thorough inspection of it as soon as possible, the Supreme Court of Wisconsin, in Hayden vs. Carey, reversed a judgment of dismissal entered by the lower court which overruled the jury on a special verdict. The Supreme Court remanded the case with directions to enter judgment for the plaintiff, holding that the question of negligence was for the jury to decide, that such negligence was the proximate cause of injury, and that one who had little or no knowledge of electricity or experience with electrical appliances or wires, and who was injured from contact with a charged broken wire while removing broken branches and trees, following a heavy storm, was not contributorily negligent. (196 N. W. 218.)

Negligence of Electric Power Company in Matter of Broken Live Wire Is Question for Jury.—In Pricer vs. Lincoln Gas & Electric Company damages of $25,000 were awarded for the death of a motorman who stopped his car on perceiving a broken electric light wire dangling in front of it, brought the wire to the ground in some way and then attempted to handle it with a "pick-up" which was part of the equipment of the car, but fell on the wire and received injuries from which he died. The question of negligence on the part of the power company was, the Supreme Court of Nebraska held, rightly submitted to the jury and the amount of damages was not excessive as the man was the head of a family, was only twenty-four years old and had an expectancy of thirty-seven more years. The court disregarded the company's plea that the fall of the wire was due to a storm, evidence showing that the storm was not one of unusual violence and there being testimony also that the company had neglected to act promptly on its first information, though this the defendant denied. (196 N. W. 150.)

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, New Equipment Available, Foreign and Construction News

Trend in Prices of Electrical Materials Since 1914

GOVERNMENT and various economic bureaus have gathered and published large quantities of detail comparative cost data pertaining to the activities within many of the primary industries of the country, but so far as is known cost and selling data on electrical materials have been entirely overlooked. The variations in the prices of iron and steel, lumber, food, clothing and other outstanding commodities since 1913 are commonly known, but the selling price of poles, wire and batteries for the past ten years is available only to those who have at a great expense kept very close and continual contact with the market for electrical materials.

With a view toward filling this gap in the statistics of the industry, the ELECTRICAL WORLD, has obtained from a fully authoritative source the following comparative data on manufacturers' selling prices of a number of representative electrical commodities. These are presented herewith. The data are given in form of index figures based on 1914 prices, making it possible to arrive at the manufacturers' selling price of any one of the items for any date since 1914 if the price is known for any period between 1914 and 1923. The figures

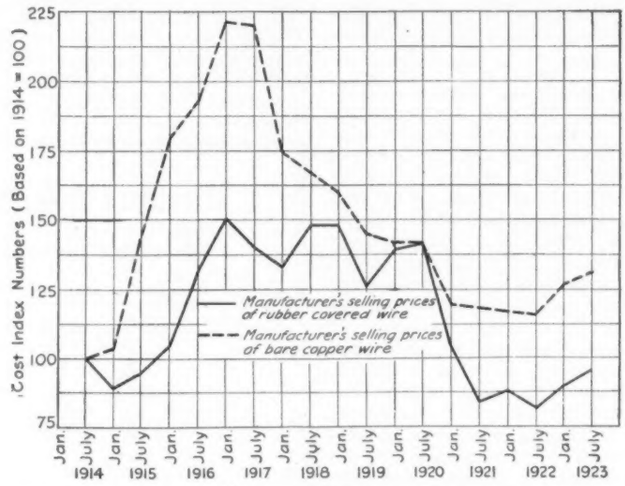

Cost Index Numbers (Based on 1914 = 100)
225
200
175
150
125
100
75
Manufacturer's selling prices of rubber covered wire
Manufacturer's selling prices of bare copper wire
Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923

FIG. 2—IN JULY, 1922, THE PRICE OF RUBBER-COVERED WIRE WAS 18 PER CENT UNDER THAT OF 1914

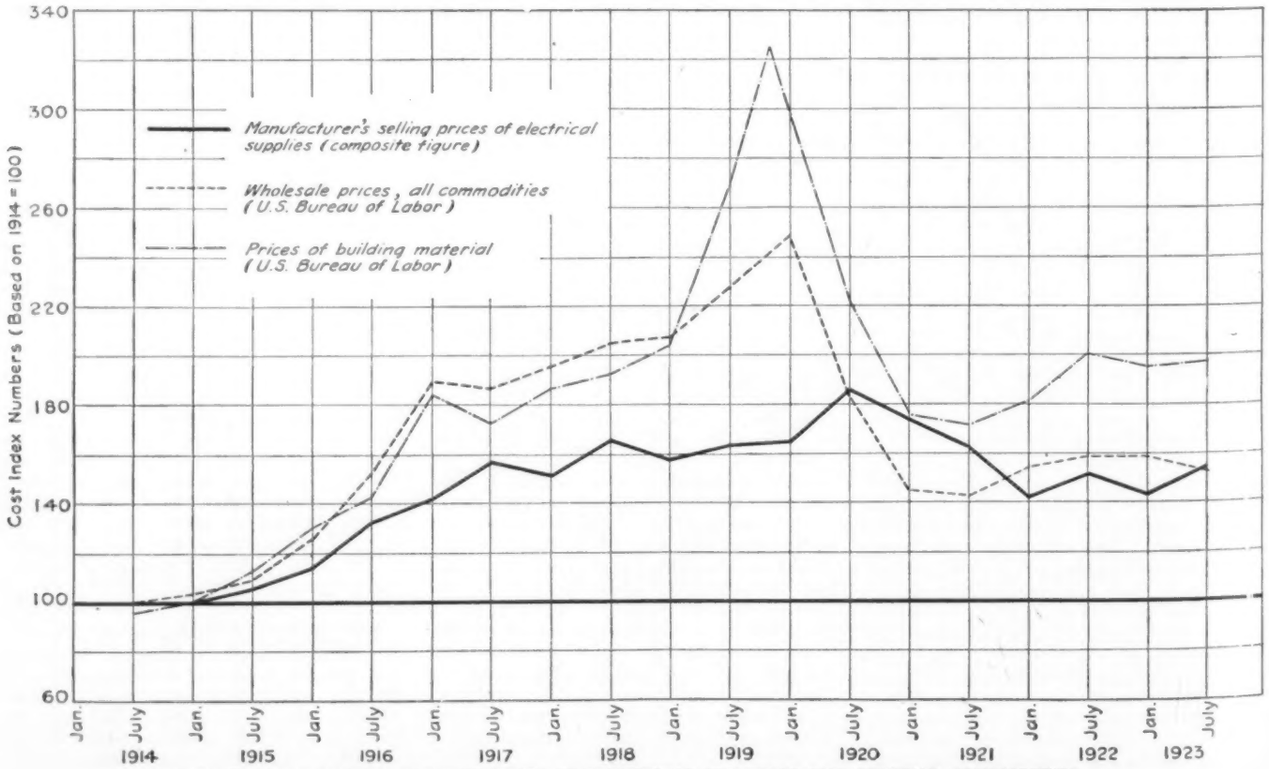

Cost Index Numbers (Based on 1914 = 100)
340
300
260
220
180
140
100
60
Manufacturer's selling prices of electrical supplies (composite figure)
Wholesale prices, all commodities (U.S. Bureau of Labor)
Prices of building material (U.S. Bureau of Labor)
Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923

FIG. 1—COMPARATIVE PRICE INDEXES OF ELECTRICAL MATERIAL AND GENERAL COMMODITIES

FIG. 3—JULY, 1923, PRICE OF POLE AND POLE-LINE HARDWARE 106 TO 112 POINTS ABOVE 1914 PRICE

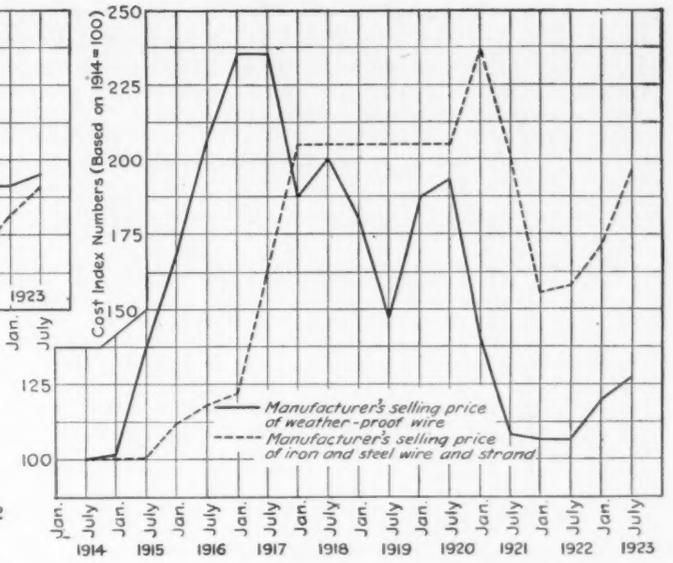


FIG. 4—WEATHERPROOF WIRE REACHED PEAK PRICE IN 1917

are, of course, national in character and are not influenced by local conditions which may exist or which may have existed during the period mentioned in any section of the country.

While all the items entering into the general group of commodities known as "electrical supplies" are not included in the accompanying table and diagrams, the thirteen items for which data are given cover approximately 75 per cent of the

Price Index of Electrical Materials at Manufacturers' Selling Prices

(Based on 1914 Prices = 100)

	1914	1915		1916		1917		1918		1919		1920		1921		1922		1923	
	Year	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July	Jan.	July
Poles	100	100	101	102	108	116	118	180	159	163	182	219	222	222	216	192	206	206	212
Weather-proof wire	100	102	137	168	207	235	235	187	200	180	147	187	193	140	108	107	107	120	127
Pole-line hardware	100	100	100	100	151	215	215	239	239	239	194	217	275	259	195	161	170	190	206
Iron and steel wire and strand	100	101	101	112	118	122	163	205	205	205	205	205	205	237	202	156	158	172	197
Bare copper wire	100	104	145	180	193	222	221	175	193	160	145	142	142	120	118	105	116	127	131
Incandescent lamps	100	95	86	86	96	86	86	95	95	95	95	127	127	127	127	127	111	101	92
Dry batteries	100	100	170	153	170	170	170	194	194	218	218	218	218	243	200	200	194	194	194
Rubber-covered wire	100	89	95	105	133	151	140	133	148	148	127	139	142	105	84	88	82	90	96
Flexible cords	100	103	104	123	164	225	225	210	216	226	202	241	262	182	139	120	117	133	147
Rigid conduit	100	86	102	112	137	165	247	247	234	229	214	214	223	214	179	143	145	170	192
Schedule material	100	103	108	119	136	171	171	171	171	199	199	199	216	216	199	142	128	150	171
Tapes and compounds	100	100	100	100	100	111	111	161	200	211	211	246	292	228	206	183	163	180	180
Standard porcelain	100	100	100	80	118	136	185	185	206	206	139	278	348	348	222	222	133	133	120
Electrical supplies (composite figure)	100	99	195	114	132	142	157	152	166	159	164	165	186	174	163	143	152	145	155

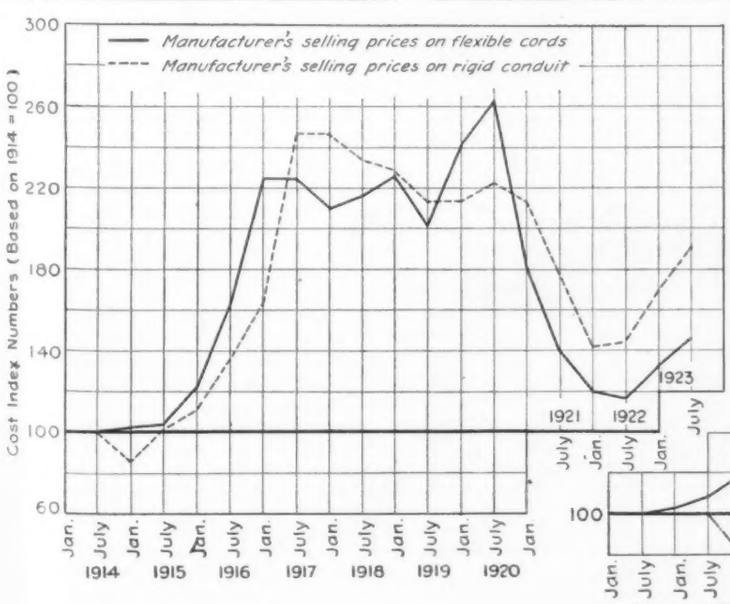


FIG. 5—PRICES OF FLEXIBLE CORDS AND RIGID CONDUIT MORE THAN DOUBLED FROM 1917 TO 1921

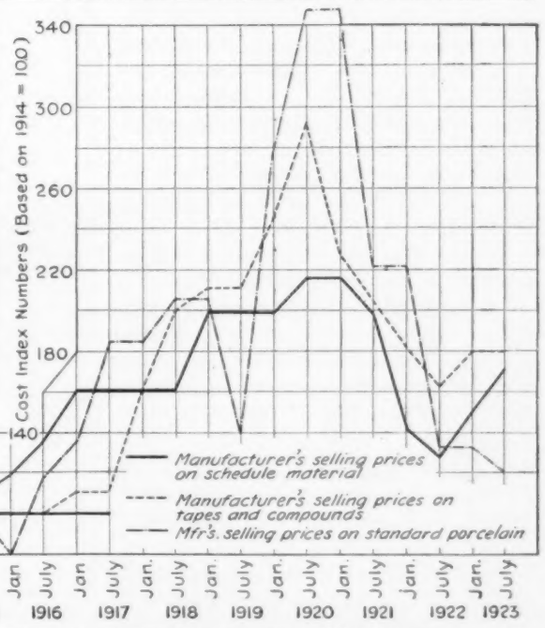


FIG. 6—PRICE OF PORCELAIN DURING 1920-1921 WAS THREE AND A HALF TIMES THAT DURING 1914

electrical supplies manufactured. The latest figures given are for July, 1923, but prices on Jan. 1, 1924, which, of course, are not yet available, will show some difference on

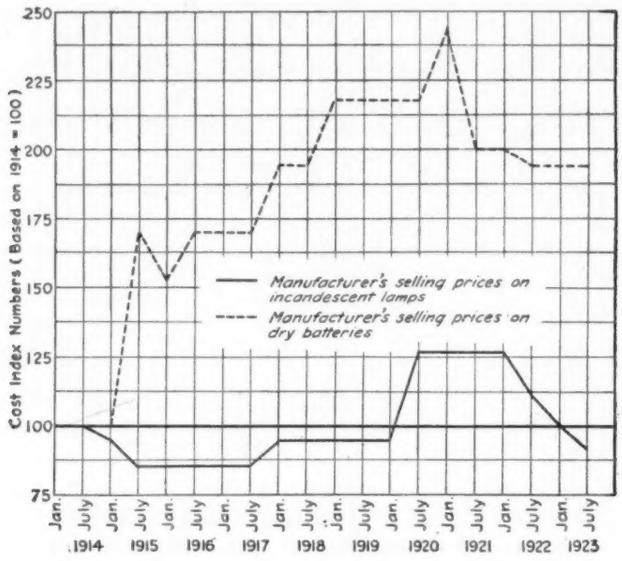

Cost Index Numbers (Based on 1914 = 100)
250
225
200
175
150
125
100
75
Manufacturer's selling prices on incandescent lamps
Manufacturer's selling prices on dry batteries
Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July Jan. July
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923

FIG. 7—HIIGHEST PRICE ASKED FOR INCANDESCENT LAMPS WAS ONLY 27 PER CENT ABOVE 1914

specific commodities, but it is believed that the composite figure will not have materially changed.

Diagram 1 shows clearly the extent to which the prices of these electrical supplies as a whole have been held down by manufacturers since 1914, as compared with the wholesale prices of commodities in general and the soaring prices asked for building materials. The gain over 1914 recorded for electrical supplies in general during the peak year of 1920 was about 35 per cent below the price of commodities in general and 112 per cent under the prices set on building materials. In July of last year the price of electrical supplies in general was about 16 per cent below the price of commodities and 80 per cent below the price of building materials.

The prices of pole and pole-line hardware are interesting examples of commodities that have remained very close to the pre-war figure through the first of 1916. At this time prices of these items took a distinct upward swing, reaching the high price for poles in July, 1920 and 1921, 122 per cent above the 1914 price. Subsequent to that date pole prices declined, but in July, 1922, they again turned upward till in July, 1923, they were 112 per cent above the pre-war figure. Pole-line hardware reached the peak in prices in January, 1921, when an increase of 159 per cent as compared with 1914 was recorded. In this item also a subsequent decrease was witnessed and later an increase, the price in July of last year being 106 per cent above the pre-war figure.

The prices of wire have varied considerably for the various classes. Weatherproof wire witnessed the greatest gain in price with 135 per cent in 1917, while rubber-covered wire actually decreased in price during 1915, only reaching a maximum point of 51 per cent above 1914, and in July of last year was 4 per cent below the 1914 price. With the exception of incandescent lamps, this is the only item for which a price lower than 1914 was recorded in July, 1923.

The price of incandescent lamps was downward till 1918, and the maximum price since 1914, recorded in 1921, has been only 27 per cent above that year and has shown a steady decrease since the opening of 1922. The price cut made at the end of last month in incandescent lamps brings the present price-index figure for this item very close to 83 as compared with an index of 100 for 1914. During this ten-year period the cost of illumination from incandescent lamps has materially decreased. In 1921 the consumer paid a dollar for 9,903 candle-hours of illumination, using the drawn-wire tungsten lamp, while in 1922 the gas-filled tungsten lamp made possible 16,200 candle-hours for a dollar. Few items essential to human progress and happiness can present such figures of declining prices with greatly increased service.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

REPORTS throughout the country this week prove that the optimistic feeling of the electrical industry is based on a very healthy business condition. Volume of sales is reported not only as good but as generally well diversified, with January sales better than last year and with February sales so far indicating that a very satisfactory month can be anticipated.

The demand in the New York district continues to be good for this period, the week in general having been quiet with the exception of a reduction of approximately 8 per cent in conduit boxes and a rumor of a decrease in price on non-renewable, non-indicating fuses which is of great significance to the renewable-fuse industry. Business on the Pacific Coast shows a remarkably healthy tone, and there exists a large and evenly proportioned demand for building staples. A feature in the Southeast is the increase of sign business, and several good contracts have been closed for this class of business. The Middle West reports the placing of some very large construction orders, which should still further stimulate the present active business. New England also reports a well-diversified volume of business, in many cases in excess of last year's figures. Buyers continue to watch the market closely, competition is keen in nearly all lines and buying is cautious though in good volume, a condition that operates to stabilize the industry.

Circuit-Breaker Deliveries Improving — Standardization of Benefit

OIL-CIRCUIT-BREAKER deliveries have been steadily improving, although the situation is still bad. Manufacturers quote from two to six weeks' delivery for 300 amp. to 1,200 amp. and up to 4,500-volt industrial breakers, with eight to twelve weeks for somewhat higher voltages and four to six months for breakers of still higher capacity. There is a small stock of oil circuit breakers, but these are of low capacity.

Air-circuit-breaker deliveries are somewhat better, with manufacturers quoting from one to four weeks for anything up to 1,000 amp.—seldom more than four weeks, although some manufacturers are quoting up to eight weeks for this type of breaker. Motor-operated or solenoid-operated types require about twice as long a time for delivery. One manufacturer reports that deliveries of Monson slate are the limiting feature of delivery of the air circuit breaker when a slate thicker

than 2 in. is required, and that were it not for poor slate deliveries 90 per cent of his apparatus could be shipped in three weeks. However, no real difficulty is experienced in obtaining 1-in., 1½-in. and 2-in. slate.

For the last two or three years manufacturers have been devoting most of their energies to the development of the high-capacity oil circuit breaker to meet the unusual demand for power interconnection fostered by the superpower idea. Now, however, manufacturers have been enlarging facilities to take care of the industrial demand, which has been constantly increasing, so that there is a consequent bettering of deliveries. To help this situation standardization has been resorted to to decrease the number of varieties in parts, and incidentally this will also decrease costs to a degree that may be reflected in reduced prices, although prices are now firm and there is no indication of any changes. One manufacturer of air circuit breakers reports that he has made no price changes in two years.

The demand for circuit breakers has been exceptionally good during the last few months. It is tapering off slightly now, but this is considered only a normal condition and does not indicate a general decrease in business. There seems to be an interesting general trend toward the use of air circuit breakers for alternating current on low voltages (220, 440 and 550) where formerly engineers considered the oil circuit breaker as the only one that could be adapted to the installation.

New Scale of Lamp Prices Shows Cumulative Reduction

THE general price reduction on tungsten lamps, already announced in these columns, is awakening a great deal of attention throughout the industry, it being the fourth substantial lowering of cost to the public that has taken place within a period of two years. It is common knowledge among electrical men that lamps are one of the very few commodities that sell to-highest peak price at any period since 1914 was only 3½ per cent above the pre-war price.

REDUCTION OF LAMP PRICES IN A TWO-YEAR PERIOD

Size of lamps (watts) Mazda B:	Jan. 1, 1922	April 1, 1922	Oct. 1, 1922	May 1, 1923	New Prices Feb. 1, 1924
10-50	$0.40	$0.35	$0.35	$0.32	$0.30
Mazda C:					
50	0.60	0.55	0.55	0.50	0.45
75	0.70	0.70	0.60	0.55	0.50
100	1.00	0.95	0.75	0.70	0.60
150	1.40	1.30	1.00	0.90	0.75
200	1.90	1.80	1.30	1.15	1.00
300	2.80	2.50	1.90	1.75	1.60
500	4.15	3.75	2.75	2.50	2.35
1,000	6.70	6.00	4.50	4.25	4.00

day to the householder for less than before the war. It is generally remembered that there have been several price changes downward recently, but how great the aggregate reduction is in actual dollars and cents is not appreciated until it is presented in actual comparison as shown in the table herewith.

Taking all sizes of lamps and weighing them in proportion to the present demand, the price today is 30 per cent below the pre-war price (averaged throughout the year 1914) and the

Large Construction Orders in Middle West—Market Active

GENERAL business continues active in the Middle West this week. Several large construction orders were obtained, one running over the million mark. Distributors are being asked to quote on a larger quantity of various commodities than usual, and the tendency seems to be toward more general purchasing, with the cautious feeling of the last eight weeks less apparent. Manufacturers are offering various inducements to obtain business and the supply market is highly competitive. There has been a good demand for poles following the recent Mid-Western storm. Pole-line hardware demand has been good and other line material has been moving. Conduit sales are increasing, and deliveries are prompt. Radio sales continue excellent, although the shortage of tubes, particularly the 201-A, has not been relieved to any great extent. Rubber-covered wire demand and prices remain steady.

Electric motor vehicle manufacturers state that 1924 has opened up very favorably. A number of local manufacturers have adopted this mode of transportation. Central stations have found the equipment advantageous and have been purchasing rather heavily of late. Fuse sales are normal for this time of year with sales highly competitive, but prices remain firm.

Conditions Healthy in Southeast —Sign Business Active

THE generally healthy condition in the Southeast is reflected in the value of building contracts of nine states during January, the total being $40,632,000. There is noticeable activity among Florida utilities in line extensions and additional decorative lighting facilities. A number of the larger towns in central Florida are being interconnected, and this work is of course calling for a satisfactory volume of line and station material. The electrical jobbing business is holding up well and prices are stable.

The sign business is increasing steadily and has reached a stage where small signs practically sell themselves. Prospects for the larger signs have been followed up closely, and as a result contracts for three 8,000-watt installations in Atlanta have been recently announced. The outlook is particularly good because sign activities have not kept pace with other developments. Recent announcements of manufacturers regarding the introduction of new radio equipment have tended materially to slow up sales in this section. Manufacturers, however, are only promising long deliveries on limited orders for the new models.

Demand Continues Good in New York District

THE demand in the New York district continues to be very satisfactory for this period, with preparations well under way for the normal increase in the spring buying. There is no difficulty in obtaining materials and stocks are good. A leading manufacturer of conduit boxes announced a decrease of approximately 8 per cent early in the week, and it is rumored that non-renewable, non-indicating fuses are expected to decrease in price. Manufacturers continue to sell armored cable at a very low price which they claim is below cost and due entirely to the highly competitive condition existing, and present prices cannot be expected to continue long under these conditions. In spite of the price changes by one manufacturer on rubber-covered wire last week, prices on this commodity are stable; but it is expected that as soon as the copper market strengthens rubber-covered wire will advance, particularly since present prices are low, and cotton has increased in price.

There was a rumor last week that conduit may increase in price, but it is not now expected to do so. Prices in general continue to be stabilized, a condition that has been assisted by the good weather, which accelerated building operations; but while there are not expected to be any very definite price movements with the increased demand in the spring, there may be some very slight increases, possibly 3 to 5 per cent at most, as manufacturers are now working on such small margins.

Healthy Tone Indicated on the Pacific Coast

ELECTRICAL trade conditions on the Pacific Coast exhibit a large and evenly proportioned demand for building staples, with improved deliveries due to excellent manufacturing co-operation. February sales of electrical material have so far met the high expectations, and last month's business, although less than December's, ran well ahead of a year ago. Vigorous "missionary" effort is being exerted by sales forces in exploiting the latest wiring device improvements, including switch refinements such as luminous indicators and composition bodies, with considerable attention being paid to neater packing and labeling for shelf display. Toggle switches and candle sockets are in active demand and are attaining price levels comparable with push switches. Residential and industrial wiring predominate, and not a little large construction is projected.

Government business is temporarily quiet, but the new determined drive for the Alameda naval base may result in

an enormous naval construction program, particularly in electric power applications. Export business is much better, exchange is steadily improving and Mexico shows a distinctly favorable reaction to the collapse of the insurgent forces. Power business is good despite the usual winter pulling off of the main construction crews, and there is a steady call for station material, insulators, switches, meters and transformers. However, pole-line hardware is rather quiet in the face of rumored decreases in the price of steel.

Business in New England Good with Diversified Sales

A WELL-DIVERSIFIED volume of business, running in many cases considerably ahead of last year's figures, is reported by New England jobbers. Prices are steady and deliveries in the main are satisfactory, the principal shortage Tuesday being in radio tubes. Wiring-device manufacturers are meeting increased demands from jobbers to replenish rather low stocks in anticipation of spring business.

Buyers are watching the market closely, and competition is acute in power-plant auxiliary equipment, especially for the boiler room. The textile centers are operating to a large extent on part time, and electrical purchases from most of the cotton mills are on a very conservative basis. Wire and conduit are in easy supply, with a healthy demand from the building industry, and line materials are moving well. Appliance sales have made an admirable record so far in 1924. However, commitments in large engineering projects are cautious, though much investigation is under way.

The Metal Market

COPPER can now be said to be in line with the other non-ferrous metals in an advancing market. Lead continues to be scarce with higher prices, the demand for zinc has been unusually great and there does not seem to be a sufficient quantity of tin available for prompt delivery to meet the demand.

Copper was selling a week ago for

NEW YORK METAL MARKET PRICES

	Feb. 6, 1924 Cents per Pound	Feb. 13, 1924 Cents per Pound
Copper, electrolytic	12⅛	12⅛
Lead, Am. S. & R. price	8.15	8.25
Antimony	10.50	10.50
Nickel, ingot	26 to 30	28
Zinc, spot	7.00	7.10
Tin, Straits	51⅞	54
Aluminum, 98 to 99 per cent	27.50	27

12⅛ cents by at least two producers, but there is no more metal available at this price. The average price was 12⅝ cents, with 12¾ cents obtainable in the last two or three days. On Wednesday some copper was sold as high as 12⅞ cents and no one seems willing to accept less than 12¾ cents, even though the consumer is situated near the refinery. The foreign demand, which has improved, probably assisted in playing a part in making producers more optimistic as to prices.

Activities of the Trade

Devoted to News of the Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Hemingray Glass Company Appoints New Secretary

The Hemingray Glass Company, Muncie, Ind., has appointed Willard P. Zimmerman as secretary to succeed W. Edgar Evans, who has retired as secretary and director of that company. Mr. Evans will still retain his interest in the organization, although he will no longer take an active part in its management.

Hudson Electrical Supply Under New Ownership

O. Fred Rost, general manager of the Newark Electrical Supply Company, Newark, N. J., has purchased the Hudson Electrical Supply & Equipment Company, 572 Newark Avenue, Jersey City, and will in future also serve as president and general manager of the new company.

The Hudson company will operate as an electrical supply jobbing house with a separate and distinct organization and will carry a complete stock of electrical materials. The interest of Mr. Rost in the Hudson company will in no way affect or change his connection with the Newark company.

Mine & Smelter Supply Company Changes Personnel

Malcolm H. Carpenter, formerly manager of the San Francisco branch of the Mine & Smelter Supply Company, Westinghouse agent-jobbers, has taken over the managership of the El Paso branch of that company. Irving B. Boyer, formerly with the Westinghouse Electric & Manufacturing Company at East Pittsburgh, who joined the sales force of the Mine & Smelter Supply Company as a lamp specialist, has been made a general salesman for that company, handling all of its material.

New Indianapolis Manufacturers' Representation

The Scott-Jaqua Company, Inc., has opened offices in the Roosevelt Building, Indianapolis, as a firm of electrical sales representatives and engineers, in order to serve that territory with construction and illuminating materials. The principals in the company are John F. Scott, formerly vice-president and general manager of the Varney Electric Supply Company, Indianapolis, and Charles A Jaqua, formerly department manager and engineer of the same company.

In addition to the merchandising activities of this new organization, it also offers an engineering service. Among the manufacturers it represents in Indianapolis are the American Steel & Wire Company, Frank Adam Electric Company, Kuhlman Electric Company, Electrical Engineers Equipment Company, T. M. Partridge Lumber Company and Pittsburgh Reflector Company.

Mitchell-Rand Distributors for Plymouth Rubber Company

The Mitchell-Rand Manufacturing Company, 18 Vesey Street, New York, has arranged to act as Eastern distributor for the Plymouth Rubber Company, Inc., Canton, Mass., and now carries in its warehouse a complete stock of Plymouth friction tapes and splices, insuring immediate deliveries. Maurice J. Deegan is supervisor of the new tape and splice department of the Mitchell-Rand company.

Maytag Company Ships Another Trainload East

On January 29 the Maytag Company, Newton, Iowa, sent another trainload of washers, comprising thirty-two cars with a retail value of over $500,000, to its Eastern distributors. This was the fifth trainload sent east since May, 1923. At the 1924 annual convention of Maytag dealers and distributors, held the first week in January, F. L. Maytag, chairman of the board of directors, announced that the gross volume of business for 1923 amounted to $5,847,530.08, the Philadelphia territory sending in the greatest amount—$1,593,378.63. It is said that a new foundry which has recently been acquired at a cost of over $100,000 will increase production to more than 600 machines a day.

International Purchasing Agents' Convention

The ninth annual international purchasing agents' convention will be held during the week of May 19 next in the Mechanics' Building, Boston. As a part of the convention there will be conducted an exhibition known as the "Informashow" where manufacturers will be given an opportunity to demonstrate the quality of their products. It is expected that there will be at least three thousand purchasing agents present.

Electrical Industry Active in "Own Your Home Exposition"

The construction and allied interests are preparing for the Chicago annual "Own Your Home Exposition," which will be held at the Coliseum from March 22 to 29, and for the New York annual "Own Your Home Exposition," to be held at the Sixty-ninth Regiment Armory from April 19 to 26. Under the slogan "Electrify your home," the Chicago exposition's electrical industries committee is assembling the many products of the industry, and a special

part of the Coliseum floor has been set aside for these exhibits.

The members of the electrical industries committee for the Chicago exposition include F. Lee Farmer, chairman, Beardslee Chandelier Manufacturing Company; J. W. Busch, Westinghouse Electric & Manufacturing Company; William H. Colman, General Electric Company; George B. Foster, Dana Howard and Oliver Hogue, Commonwealth Edison Company; Otis L. Johnson, King Manufacturing Company; Paul W. Koch, president Electric Club of Chicago; P. A. Powers, Benjamin Electric Manufacturing Company, and H. T. Van Riper, Edison Electric Appliance Company.

The Ideal Electric & Manufacturing Company, Mansfield, Ohio, has appointed Russell A. Reed, Inc., 30 Church Street, New York, as exclusive export sales manager.

Chester E. Collier, recently with the Chicago office of the Square D Company, is now a representative of Henry D. Sears in the exploitation of Weber wiring devices in Ohio, Indiana and Michigan with headquarters at Cleveland. He succeeds Robert J. Jones, who recently resigned.

The Electric Manufacturing & Repair Company, 400 Duquesne Way, Pittsburgh, has purchased property on Chateau Street for approximately $50,000 and will remodel and improve it at an early date.

The National Metal Molding Company, Fulton Building, Pittsburgh, has plans under advisement for the erection of a one-story addition at its plant at Ambridge, Pa., 130 ft. x 400 ft., to cost about $55,000.

The Trumbull-Vanderpoel Electric Manufacturing Company, Bantam, Conn., announces that L. B. Underwood, Philadelphia, who has heretofore covered the eastern Pennsylvania territory, now covers the entire state with an additional sales office in Pittsburgh. Also the A. R. McNally Company, Cleveland, formerly representative in northern Ohio, will now cover the entire state.

The Frank Adam Electric Company, St. Louis, has appointed Joseph Mann, 116 West Twenty-second Street, New York, as its representative. Mr. Mann was formerly associated with the home organization in St. Louis for over fifteen years.

The Heine Boiler Company, St. Louis, announces that the Tennant Company, Union National Bank Building, Houston, will now represent it in the southern half of Texas. Smith & Whitney, Dallas, will continue as the company's representatives in the northern half of Texas.

The Marble Card Electric Company, Gladstone, Mich., is building a new line of ballbearing alternating-current motors up to 25 hp.

The Electric Power Equipment Corporation, Philadelphia, has announced the appointment of two new district representatives, Elliott E. Van Cleef, 53 West Jackson Boulevard, Chicago, and W. T. White & Company, Metropolitan Life Building, Minneapolis.

The Western Electric Company's supply department office, Minneapolis, has been moved to 413-417 South Fourth Street. A feature of this office is an up-to-date display room on the main floor which dealers are invited to use for the purpose of demonstrating Western Electric household appliances to prospective customers.

The Robbins & Myers Company, Springfield, Ohio, has placed on the market a new 8-in. alternating-current induction-type fan, known as model 41.

The American Electrical Works, Phillipsdale R. I., have awarded a contract for the erection of a new one-story manufacturing building, 80 ft. x 279 ft., at a cost of approximately $100,000.

The United States Light & Heat Corporation, Niagara Falls, N. Y., has preliminary plans under advisement for the reconstruction of its branch plant at Niagara Falls, Ontario, which was destroyed by fire January 26, with loss aggregating close to $100,000. The company is said to be considering the acquisition of another site for a larger pant.

The Cosmo Electric Plant & Supply Company recently incorporated under the laws of the State of Missouri, has opened offices in the Holland Building, St. Louis. It will handle the Westinghouse Electric & Manufacturing Company's farm-lighting outfit along the Mississippi Valley and will also be agents for various powerplant supplies and other electrical equipment. J. Carter Carstens is president, W. H. Spear vice-president and V. P. Gabriel secretary and treasurer.

The Hazard Manufacturing Company, Wilkes-Barre, Pa., has announced the appointment of Daniel J. Morgan, for several years sales agent of the insulated wire department of the Company, as sales engineer with the general offices at Wilkes-Barre. Leroy W. Allen has also been appointed sales engineer of the New York office.

The Standard Turbine Corporation, Scio, N. Y. announces the appointment of Halloran & Golcher, San Francisco, and the Industrial Sales & Engineering Company, Omaha, as their representatives.

The Emerson Electric Manufacturing Company, St. Louis, has discontinued its 16-in. non-oscillating fans and also the 9-in. three-speed non-oscillating fan for alternating current, the latter type being superseded by its 9-in. single-speed Emerson Junior fan. The company has not discontinued the 9-in. three-speed non-oscillating fan for direct current.

"Delco Light" Men Convene.—The "Delco Light" and "Frigidaire" dealers of Georgia held a two-day convention in Atlanta, beginning January 21, with an approximate attendance of sixty. Besides demonstrations of equipment recently put on the market, there were addresses by several department heads from the factory.

The Trumbull Electric Manufacturing Company announces that it has added Eric Foster Storm and H. L. Wheeler to the sales force of its Eastern sales office, with headquarters in New York.

The Westinghouse Electric & Manufacturing Company has announced the appointment of the Mann Electric Supply Company, Columbia, S. C., as its representative in distributing electrical apparatus. The Mann company will carry a complete stock of motors, meters, transformers, line materials and other electrical equipment.

The General Electric Company has announced a new opportunity for employees to subscribe to the 8 per cent bonds of the Employees' Securities Corporation. The bonds will be offered March 1 to employees who have had six months' service or more. At the present time over 25,000 employees of the General Electric Company hold such bonds or are making payments on them.

New Equipment Available

Short Descriptions of New Apparatus and Accessory Equipment of Interest to the Electrical Industry and Available from Manufacturers and Announcements of New Lines

Refractor for Street Lighting Units

A new refractor, known as the "Bi-Lux" refractor, which it is said will increase the effective illumination from street-lighting units approximately 70 per cent as compared with the most efficient units now in service, has been developed by the Westinghouse Electric & Manufacturing Company in cooperation with the Holophane Glass Company. Tests made by the Electrical Testing Laboratories of New York show that a 400-cp. lamp within the refractor inclosed within a Westinghouse clear rectilinear glass globe will deliver 2,000 cp. up and down the street, 425 cp. across the roadway at right angles to the curb line and 250 cp. across the sidewalk. As a result of this method of "spraying" the light, the street is evenly illuminated over its entire surface and there is no glare in the eyes of motorists or pedestrians.

The refractor is mounted inside the globe of the lighting unit and surrounds the lamp. It consists of two cylindrical pieces of pressed crystal glass nested one within the other and clamped together so as to form a single unit, the shape of which is a frustum of a hollow cone. The inside surface of the inner element and the outside surface of the outer element are smooth, so that in the assembled unit the exterior is easily cleaned.

Automatic Starter.—The CR-7022 automatic starter, a new General Electric device, is designed for use with slip-ring induction motors and is generally similar to the CR-7056 starter for squirrel-cage motors.

New Trade Literature

ELECTRICAL SPECIALTIES.—The W. N. Matthews Corporation, St. Louis, is distributing a folder covering the "Matthews" electrical and mechanical specialties, including lamp guards, guy clamps, switches, etc.

MANHOLE OIL SWITCHES. — Bulletin No. 429-3 issued by the Condit Electrical Manufacturing Company, South Boston, Mass., describes its "Condit" type M-5 and M-6 manhole oil switches.

IMPULSE TURBINES. — The Pelton Water Wheel Company, Nineteenth and Harrison Streets, San Francisco, has issued bulletin No. 19, covering its impulse turbines and accessory equipment.

TREATMENT OF BOILER-FEED WATER.—The H. S. B. W. Cochrane Corporation, Seventeenth Street below Allegheny Avenue, Philadelphia, is distributing a pamphlet entitled "The Treatment of Boiler-Feed Water for Highly Overloaded Boilers," by David Henderson, engineer Dravo-Doyle Company, in which the effect of suspended matter, sodium salts and organic matter in promoting foaming and priming is discussed. It also contains a statement outlining in what respect water treated at boiling point is best adapted for use in overloaded boilers.

INSULATORS.—The R. Thomas & Sons Company, East Liverpool, Ohio, is distributing a leaflet covering its cemented-type insulators, No. 1166 and No. 1167. The company has also issued a folder calling attention to the "Thomas Quality" suspension units.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Purchase is desired in Weltevreden, Java (No. 9,094), for electrical appliances and lighting and telephone equipment.

Purchase is desired in Cienfuegos, Cuba (No. 9,086), for electrical water sterilization apparatus.

Purchase is desired in Riga, Latvia (No. 9,099), for portable welding machines, tools and lathes.

Purchase is desired in Rio de Janeiro, Brazil (No. 9,090), for pulverized coal-burning apparatus.

Purchase is desired in Penang, Straits Settlements (No. 9,128), for an ice-manufacturing plant and refrigerating vault.

Purchase is desired in Antwerp, Belgium (No. 9,125), for sugar manufacturing machinery, especially cranes, conveyors and pneumatic packing machinery.

An agency is desired in Basle, Switzerland (No. 9,142), for electrolytic copper in cakes, wire bars, billets and ingots.

HYDRO-ELECTRIC PROJECT FOR LITHUANIA.—Bids are being asked by a power company in Lithuania, *Commerce Reports* states, for the construction of a large hydro-electric plant on the Villa River near Kovno. Bids are to be submitted for the entire concrete work, a dam and sluice, turbine room and other buildings, and for all iron construction such as sluice boards, sluice gates, etc., but excluding turbines and electrical equipment, for which special bids will be requested. The initial installation will cost about $500,000. The plans provide for an ultimate development of 60,000 hp., to cost $3,500,000 additional.

PROPOSED POWER STATION TO BE ERECTED IN QUEENSLAND, AUSTRALIA.—A public service corporation, *Commerce Reports* states, is planning to build an electric power station to supply electricity to an important coal center near Brisbane, Australia. Further information may be obtained on application to the Bureau of Foreign and Domestic Commerce by referring to file No. 117,174.

WHARF, CREOSOTING PLANT AND POWER PLANT IN NICARAGUA. — The construction of a large concrete wharf, creosoting plant, a small wireless station and a large power plant and the installation of a large plant to distill turpentine, according to *Commerce Reports*, is contemplated by a lumber company in Nicaragua. Further information may be obtained on application to the Bureau of Foreign and Domestic Commerce, Washington, D. C., by referring to file No. 117,879.

ELECTRIC POWER PLANT FOR RAILWAYS AT CAPE TOWN, SOUTH AFRICA. —Tenders are being called by the South African government, according to *Commerce Reports*, for the construction of an electric plant at Cape Town, South Africa, for the railways. Specifications may be obtained from Merz & McLellan, 32 Victoria Street, London, England, engineers in charge.

New Incorporations

THE CLEATON (KY.) LIGHT & POWER COMPANY has been incorporated by Charles Harper, J. F. Johnson and others.

THE YOUGHIOGHENY HYDRO-ELECTRIC COMPANY, Baltimore, has been incorporated with a capital stock of $13,000,000 by William D. Macmillan, Joseph T. Brennan, Equitable Building, Baltimore, and Arthur D. Thompson, 206½ Prospect Avenue, Baltimore. The company will operate as a distributing company for the Youghiogheny Power Company, which is building an electric power plant on the Youghiogheny River in Garrett County.

THE INDIANA SUPER-POWER COMPANY, Gary, Ind., has been incorporated by J. B. Thiess, N. M. Files, A. F. Mecklenburger, Thorley von Holst and G. W. Hansen.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

PORTLAND, ME. — The Cumberland County Power & Light Company, Portland, has awarded a contract for foundations and building for the proposed addition to its plant at Knightville. Contracts for equipment, it is understood, will be placed immediately.

LAWRENCE, MASS.—Petitions have been presented to the City Council for the installation of ornamental lamps on Park Street and South Broadway.

MIDDLEBORO, MASS.—The Board of Selectmen contemplates increasing the facilities of the municipal electric plant. Two propositions are being considered, one to install additional equipment in the power plant, at a cost of about $125,000, and the other to erect a high-tension transmission line to connect with a power station in New Bedford, to cost $40,000.

BRISTOL, CONN.—The Bristol & Plainville Electric Company is having plans prepared for the construction of an addition to its local generating plant. The Charles H. Tenney Company, 200 Devonshire Street, Boston, is engineer.

WATERBURY, CONN.—The Connecticut Light & Power Company plans extensions in its generating plants during the present year to increase the capacity by 90,000 hp.

Middle Atlantic States

BROOKLYN, N. Y. — Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 26, for eight storage-battery-testing outfits, 920 hydrometers and other apparatus for the local navy yard. (Schedule 1887.)

BUFFALO, N. Y.—Bids will be received by the Commissioner of Public Works, Municipal Building, until Feb. 28, for a switchboard and switchboard apparatus, motors and centrifugal pumps, for the new pumping station at the filtration plant. Fuller & McClintock, 170 Broadway, New York, are consulting engineers.

MASONVILLE, N. Y. — The Masonville Light & Power Company has applied to the Public Service Commission for permission to construct and operate an electric plant in Masonville.

NEW YORK, N. Y.—The expansion program during the present year of the New York Edison Company includes an increase of about 100,000 hp. in its electric generating capacity.

NORTH TONAWANDA, N. Y.—The Tonawanda Power Company is planning extensions, including rebuilding its lines and substations to carry 60,000 volts, instead of 22,000 volts as heretofore.

PATCHOGUE, N. Y.—The Patchogue Electric Light Company is considering the installation of an additional electric generating unit during the coming year.

ROCHESTER, N. Y.—The Rochester Gas & Electric Company is planning to construct a steam-operated electric plant during the present year.

SYRACUSE, N. Y.—The Syracuse Lighting Company and the Onondaga Utilities Corporation are being merged under the name of the Syracus Lighting Company, Inc. Bonds to the amount of $7,000,000 have been issued to finance the project and for proposed extensions in the system.

SYRACUSE, N. Y.—Bids will be received at the office of the Syracuse Intercepting Sewer Board, 104 City Hall, until March 3 as follows: Contract No. 41—For bar screens and raking equipment for main sewage station; No. 42—for machinery and equipment for sludge pumping station, including four vertical triplex stuff pumps connected to 15-hp. variable-speed alternating-current motors, control equipment, etc.; No. 43—for exterior wiring and lighting for sewage-treatment works; No. 44—for transformer substation structure.

WATERTOWN, N. Y.—The Power Corporation of New York has issued $1,000,000 in debentures, part of the proceeds to be used for completion of its hydro-electric plant at Herrings, increasing the output from 3,838 hp to 8,250 hp.

NEWARK, N. J.—The Public Service Corporation contemplates extensions and improvements in its system during the present year, to cost about $20,000,000.

POMPTON LAKES, N. J.—The installation of an ornamental lighting system is under consideration by the Borough Council.

ALLENTOWN, PA.—The Paupack Power & Light Company, recently organized, will be affiliated with the Pennsylvania Power & Light Company in connection with its proposed hydro-electric development on Wallenpaupack Creek, near Wilsonville. The new company will take over and merge thirty-two power companies operating in this district and will make extensions in transmission lines.

ALTOONA, PA.—The Penn Central Light & Power Company has applied for permission to take over and consolidate seven electric utilities operating in Huntingdon and Blair Counties. Extensions will be made in the transmission system.

FAIRFIELD, PA.—The officials of the Pennsylvania Power & Light Company are organizing a subsidiary to be known as the Fairfield Power & Light Company, to erect a transmission line in Fairfield Township.

HAWLEY, PA.—The Paupack Power & Light Company has been granted permission to take over and merge thirty-two electric utility companies operating in Lackawanna, Pike, Wayne, Luzerne, Monroe and Carbon Counties. Plans are under way for the construction of transmission lines.

MIDDLEBURG, PA.—The Middleburg Light, Heat & Power Company plans extensions in its transmission system in connection with the acquisition of five electric companies now operating in Snyder County, to be consolidated with its organization.

PHILADELPHIA, PA.—A permit has been granted to William Steele & Sons Company, 219 North Broad Street, for the erection of a power house.

PHILADELPHIA, PA.—Bids, it is understood, will soon be asked by the Bureau of Surveys, Room 216, City Hall, for construction of power house at the northeast sewage-disposal plant, Wheatshead Lane.

PHILADELPHIA, PA. — The Adams Township Electric Company and the Croyle Township Electric Company, now being organized by J. V. Jahnke and William J. Faux, plan to erect transmission lines in the respective districts for which they are named. The companies are represented by Johnson, Gilkyson & Freeman, 1211 Chestnut Street, Philadelphia.

PITTSBURGH, PA. — The Duquesne Light Company is arranging a fund of $5,000,000 for extensions in transmission lines and the construction of six substations in the local district.

RIDGWAY, PA.—The Keystone Power Corporation has issued $600,000 in bonds, part of the proceeds to be used for extensions to its system.

WEST CHESTER, PA.—The West Vincent Township Power Company and the

East Nantmeal Township Power Company, now being organized to operate in the respective townships, plan to erect transmission lines. The companies are represented by James C. Jones, Bullitt Building, Philadelphia.

BALTIMORE, MD.—Bids will be received by the Board of Awards, office of the City Register, City Hall, until Feb. 20, for 50,000 ft. of 3-in. fiber conduit for the municipal electrical commission. Charles F. Goob, 311 St. Paul Place, is chief engineer electrical commission.

BALTIMORE, MD.—Application has been made for permission to consolidate the Youghiogheny Power Company, Youghiogheny Water & Electric Power Company and Youghiogheny Hydro-Electric Company to carry out a number of hydro-electric power projects in Garrett County, at Deep Creek, San Run, Swallow Falls and Crellin; also, for authority to issue $7,750,000 in bonds, the proceeds to be used for plants and transmission lines. The total development will provide a capacity of 76,000 kw. Joseph T. Brennan, Equitable Building, is representative of the Youghiogheny Power Company.

SPARROWS POINT, MD.—The Bethlehem Steel Company will install electric power equipment at its rail mill, Sparrows Point, to replace present steam-operated machinery, in connection with extensions and improvements to cost $500,000.

BLUEFIELDS, W. VA.—Plans are under consideration by the Appalachian Power Company for the construction of two new generating units, No. 5 and No. 6, in connection with the proposed dam for which property was recently purchased in Pulaski, Va.

CHARLESTON, W. VA.—The Virginian Power Company has issued $5,000,000 in bonds, part of the proceeds to be used for extensions in its system.

GALAX, VA.—The Galax Knitting Company, High Point, N. C., plans to construct an electric power plant at its proposed local mill.

HAMPTON ROADS, VA.—Bids will be taken at once by the supply officer, United States Naval Operating Base, for 6,000 ft. light and power wiring. (N. S. A. F. req. 477.)

SALEM, VA.—Plans are under consideration for public improvements, including the installation of ornamental lamps and telephone system, to cost about $20,000. J. P. Broome is city manager.

WASHINGTON, D. C.—Bids will be received by the general supply committee, Treasury Department, Washington, D. C., until March 5 for furnishing electrical, engineering and plumbing supplies (class 6) from July 1, 1924, to June 30, 1925.

WASHINGTON, D. C.—Bids will be received by the general purchasing officer, Panama Canal, until Feb. 29, for motors, electrical supplies and fixtures, wire and cable, meters, etc. (Circular 1588.)

North Central States

CLIMAX, MICH.—The village authorities have contracted with the Consumers' Power Company, Jackson, to furnish electric service here, including street lighting. A transmission line will be extended from Augusta to Climax.

HART, MICH.—The installation of a municipal electric light plant is under consideration.

JACKSON, MICH.—The Consumers' Power Company contemplates extensions and improvements involving an expenditure of about $13,000,000 during 1924. The work includes the completion of the 60,000-hp. steam-driven electric plant on the Saginaw River, completion of the 12,000-hp. hydro-electric plant on the Au Sable River, an additional 17,000-hp. generating unit at Battle Creek station and the erection of 150 miles of steel-tower high-tension transmission lines.

CLEVELAND, OHIO.—Plans have been prepared for a hospital building, nurses' home and power house for the Cleveland Homeopathic Medical Society to be erected on Terrace Road, East Cleveland, to cost about $1,000,000. H. D. Simms, 423 Erie Building, is secretary.

COLUMBUS, OHIO.—Plans are under consideration for extensions to the municipal electric plant, including the construction of a new substation on the West Side and enlarging the substation on the South Side. A main trunk line will be built from the central plant to the new substation.

LORAIN, OHIO.—The Ohio Public Service Company plans to build a new dock at its local Edgewater generating plant for intake pipe service, etc., to cost about $125,000.

McDERMOTT, OHIO.—The McDermott Stone Company plans to construct a power house at its proposed local plant, to cost about $200,000, to replace its works recently destroyed by fire.

MINGO JUNCTION, OHIO.—The Carnegie Steel Company, Pittsburgh, will install electric power equipment at the proposed addition to its local coke-unloading plant, to cost about $500,000, including hoisting, loading, conveying machinery.

SABINA, OHIO.—Steps have been taken by farmers between Sabina and Melvin to secure an extension of a transmission line to furnish electricity for residences between the two places.

TORONTO, OHIO.—The Blanchard-Ohio Edison Coal Company, recently formed, plans to install electric power equipment at its properties in this section. The company will furnish coal for the new local generating plant of the Ohio Edison Company, now in course of construction.

WOOSTER, OHIO.—The Ohio Injector Company will install electric power equipment at its proposed plant addition, to cost about $250,000.

YOUNGSTOWN, OHIO.—The Youngstown Sheet & Tube Company plans to install electric power equipment in the proposed addition to the sheet mill at its Brier Hill works, to cost about $1,250,000.

DAWSON SPRINGS, KY.—A bill appropriating $35,000 for a power plant and laundry for the Kentucky School for the Blind has been introduced in the State Legislature.

FRANKFORT, KY.—The Kentucky Northern Power Company has applied to the Federal Power Commission for permission to develop water power in the Licking River, about 3 miles from Falmouth.

COLFAX, IND.—The Northern Indiana Power Company, Kokomo, is negotiating for the purchase of the property of the Colfax Electric Company and will make extensions in the system.

HAMMOND, IND.—The Western Grain Products Manufacturing Company plans for the installation of electric power equipment in connection with the proposed rebuilding of its local plant, recently damaged by fire with loss of about $150,000.

SHELBYVILLE, IND.—The Flatrock Hydro-Electric Company, recently organized, plans to build a hydro-electric plant on the Flatrock River near the Flatrock Cave.

CHICAGO, ILL.—The Commonwealth Edison Company has arranged a fund of $29,250,000 for extensions and betterments during the present year, of which about $16,000,000 will be used for generating-plant additions and the remainder for substations, transmission lines, etc.

CUBA, ILL.—Plans are under way for the installation of an ornamental lighting system, to cost about $22,000.

SPRINGFIELD, ILL.—The Central Illinois Public Service Company has issued $2,000,000 in bonds, part of the proceeds to be used for extensions during the present year.

BELLEVILLE, WIS.—The Southern Counties Power Company has purchased the mill property at Monticello, in which it proposes to install a power plant.

MADISON, WIS.—A movement has been started by the South Side Men's Club for improvements to the lighting system on the South Side.

MEDFORD, WIS.—The property of the Medford Light & Heating Company has been acquired by the Lake Superior District Power Company, Ashland. No changes are contemplated in the local system at present. The company plans eventually to extend its high-tension transmission line from Ladysmith to Medford.

MILWAUKEE, WIS.—The Wisconsin Electric Power Company has issued $9,000,000 in bonds, part of the proceeds to be used for extensions, including an addition to its generating plant to increase the output from 100,000 kw. to 130,000 kw.

PLATTEVILLE, WIS.—The City Council has contracted with the Minneapolis General Electric Company to install an ornamental street-lighting system, to cost $20,000.

STAR PRAIRIE, WIS.—The Star Prairie Light & Power Company is considering extending its electric service to supply electricity to farmers in this vicinity.

MAPLETON, IOWA.—The Council is considering the question of establishing a municipal electric light plant.

UNDERWOOD, IOWA.—The Mills County Power Company, Ralston, Neb., is negotiating with the Council for construction of a transmission line from Treynor, Iowa, to furnish electricity in Underwood.

AUSTIN, N. D. (P. O. RHAME).—Plans are being prepared for the installation of a street-lighting system in Austin.

Southern States

HIDDENITE, N. C.—The Hiddenite Light & Power Company, recently organized, has preliminary plans for the construction of a transmission system. David Adams and E. E. Lackey, Hiddenite, are interested in the company.

RALEIGH, N. C.—The Carolina Power & Light Company has issued $1,000,000 in bonds, part of the proceeds to be used for extensions.

SOUTHPORT, N. C.—The Lindsey Fisheries Company plans to install electric power equipment in connection with the proposed rebuilding of its plant at the mouth of the Shallottee River, recently destroyed by fire with loss of about $120,000.

WAYNESVILLE, N. C.—A preliminary permit has been granted by the Federal Power Commission to the Pigeon River Power Company to build a 60,000-hp. hydro-electric development on the Pigeon River. F. R. Weller, Mills Building, Washington, D. C., is consulting engineer.

MELBOURNE, FLA.—The Council has granted the Melbourne Utilities Company a franchise to operate in Melbourne for a period of thirty years.

MIAMI BEACH, FLA.—An election will be held on Feb. 19 to vote on the proposal to issue $40,000 in bonds for a fire-alarm system.

OCALA, FLA.—Permission has been granted to the Ocklawaha Reclamation Farms for a hydro-electric project to develop 700 hp. at the government lock and dam on Ocklawaha River in Marion County.

PALATKA, FLA.—Plans are under way for the installation of an ornamental lighting system for which bonds have been voted.

FRIENDSHIP, TENN.—A. T. Nettles is reported to be interested in the installation of an electric light plant.

JACKSON, TENN.—Electrically operated pumps will be installed in connection with extensions to the waterworks, to cost about $100,000. S. Lancaster is engineer.

SPRINGFIELD, TENN.—Frank Bell and Edward Gunn contemplate the construction of a hydro-electric power plant on the Red River, to cost about $100,000.

DECATUR, ALA.—The Council is considering the construction of a municipal electric plant.

RIVER FALLS, ALA.—The River Falls Power Company has engaged the Southern Engineering Corporation, Albany, Ga., to prepare plans for a hydro-electric power plant on the Conecuh River, with initial output of 7,500 hp., to cost about $250,000. A transmission line will be built.

YAZOO CITY, MISS.—The City Council is considering plans for the installation of an ornamental lighting system on Main Street and Broadway in the business district. M. L. Culley, Jackson, is engineer.

DECATUR, ARK.—The Council has tentative plans for the construction of a municipal electric power plant, to cost about $75,000.

EL DORADO, ARK.—The installation of an ornamental lighting system in the business district is under consideration. The plans call for 191 lamp standards. The street-lighting service is furnished by the Arkansas Light & Power Company.

CARTER, OKLA.—Bonds to the amount of $25,000 have been voted for the erection of a local electric distribution system and a transmission line to Elk City. J. D. Bomford, Enid, is engineer.

ABILENE, TEX.—The West Texas Utilities Company has arranged for an exchange of power with the Wichita Falls Electric Company, West Texas Electric Company, Texas Power & Light Company and the Oil Belt Power Company. Extensions will be made in transmission lines and substations to cost about $600,000.

CLEBURNE, TEX.—The Atchison, Topeka & Santa Fé Railroad Company plans to install electric power equipment in connection with proposed extensions in its local car and locomotive shops, to cost about $450,000.

COLUMBUS, TEX.—Application has been made to the Board of Water Engineers by

Dr. A. S. McDaniels, San Antonio, and O. A. Zumwalt, Columbus, for permission to construct a dam on the Colorado River at Columbus to supply power to generate electricity for lighting the city and for power for textile mills.

DENISON, TEX.—A number of business men have applied to the City Commission for permission to construct an electric power plant to furnish electricity for their business houses and also to others in the city desiring service.

HEDLEY, TEX.—The Texas Central Power Company, San Antonio, is planning for the erection of a transmission line from Childress and the installation of a local substation.

LEONARD, TEX.—The Bailey Light & Power Company, recently incorporated, is planning to erect a transmission line (7 miles) to connect Bailey and Leonard. Material, it is understood, has been purchased.

Pacific and Mountain States

SEATTLE, WASH.—Bids will be received by the Chief Signal Officer, United States Army, Washington, D. C., until Feb. 20, for electrical equipment, including twenty condensers, two testing and signaling sets, two motors, five cable transmitters, one voltmeter, switches, etc. (Proposal C. P. 15085-E-1).

SEATTLE, WASH.—The Puget Sound Power & Light Company has applied to the supervisor of hydraulic for permission to divert 4,000 cu.ft. of water from Baker River. The proposed development, which will be known as the Baker River water-power development, Eden site, is expected to develop 65,000 hp. A dam 235 ft. high and 325 ft. long is planned.

McMINNVILLE, ORE.—Preparations are being made for extensions to the municipal electric light plant, including the installation of two 300-hp. oil engines directly connected to 250-kva. alternators, for which bids have been received.

ARCADIA, CAL.—The installation of ornamental lamps on Haven Avenue is under consideration.

FRESNO, CAL.—Work will soon begin on the construction of a 600-kva. substation at the Kerckhoff power house of the San San Joaquin Light & Power Corporation.

FULLERTON, CAL.—The Western Glass Company plans to install substation and other electric power equipment at its proposed local plant, to cost about $300,000.

HUNTINGTON BEACH, CAL.—The Board of City Trustees is considering the installation of an ornamental lighting system on Eleventh Street.

LOS ANGELES, CAL.—The Department of Public Service has applied for permission to install a number of submarine cable lines in the Harbor District, San Pedro.

LOS ANGELES, CAL.—The City Council has authorized the installation of an ornamental lighting system on Browning Boulevard and Sixth Street.

MOORPARK, CAL.—Preliminary plans have been prepared by the Conejo Irrigation District for the construction of nine storage dams, two main power plants and connecting conduit and canal distributing system, to cost about $2,000,000. Olmstead & Gillelen, 606 South Hill Street, Los Angeles, are consulting engineers.

OAKLAND, CAL.—Plans are under consideration for extensions and improvements to the street-lighting system. Carl B. Hardy is superintendent of the city electrical department.

REDONDO, CAL.—A number of public improvements, including extension to the lighting system on the main thoroughfares, are under consideration by the City Council.

DENVER, COL.—The Public Service Company of Colorado has arranged a fund of about $4,200,000 for expansion during the present year, of which about $2,000,000 will be used for extensions in northern Colorado and in the vicinity of Cheyenne, Wyo., and the remainder for extensions in the Denver territory.

Canada

HAMILTON, ONT.—The Dominion Power & Transmission Company contemplates building a substation of 10,000 hp. capacity, to cost about $250,000.

QUEENSTON, ONT.—The Hydro-Electric Power Commission of Ontario is considering the installation of units Nos. 9 and 10 in the Chippawa-Queenston plant, each unit consisting of a 55,000-hp. vertical turbine and generator. F. A. Gaby is chief engineer.

Electrical Patents

Announced by U. S. Patent Office

(Issued January 22, 1924)

1,481,577. AUTOMATIC TELEPHONE SYSTEM; B. D. Willis, Oak Park, and A. J. Ray, Chicago, Ill. App. filed Nov. 29, 1920. Means for selective signaling.

1,481,585. ELECTRIC REACTIVE WINDING; J. R. Beard, Benton, England. App. filed Sept. 16, 1919. Reactance coils and transformers.

1,481,586. WIRE CHIEF'S TEST CIRCUITS FOR TELEPHONE SYSTEMS; W. A. Benson, Chicago, Ill. App. filed Feb. 17, 1921.

1,481,614. MEASURED SERVICE TELEPHONE SYSTEM; T. G. Martin, Chicago, Ill. App. filed Nov. 10, 1920. Applied to automatic system.

1,481,648. ELECTRODE; I. H. Levin, New York, N. Y. App. filed Feb. 26, 1920. For unipolar cells for generating oxygen and hydrogen.

1,481,655. ELECTROMAGNETIC COUPLING; M. E. Thompson, Ridgway, Pa. App. filed May 20, 1922. Clutch device locks when proper speed is reached.

1,481,680. INCANDESCENT LAMP; C. Brindel, Yorktown, Ind. App. filed Jan. 10, 1921. Two-filament lamp.

1,481,692. ELECTRIC STOVE; C. H. Cook, H. J. Lewis and C. E. Lewis, Cleveland, Ohio. App. filed Aug. 4, 1921. Grill plate.

1,481,693. TROLLEY WIRE GUARD; G. W. Creech, Twila, Ky. App. filed June 26, 1923. For use in mines.

1,481,694. VARIOCOUPLER; E. G. Danielson, San Francisco, Cal. App. filed Nov. 8, 1921.

1,481,715. TROLLEY SWITCH; C. B. Jenkins, Morgantown, W. Va. App. filed July 25, 1923. For automatically cutting off current in coal mine trolleys.

1,481,729. ELECTRICAL COLLECTOR FOR LOCOMOTIVE CRANES AND THE LIKE; H. T. Nafziger, Chicago, Ill. App. filed Jan. 11, 1922.

1,481,732. TROLLEY WHEEL AND SUPPORT; S. K. Paige, Boston, and S. K. Paige, Winchester, Mass. App. filed March 14, 1923.

1,481,751. ELECTROLYTIC SEPARATOR; W. A. Sharpe, Denver, Col. App. filed April 29, 1922. Separation of metals from pulverized ores.

1,481,761. PROCESS FOR ELECTROTHERMIC PRODUCTION OF ZINC; F. Tharaldsen, Christiania, Norway. App. filed May 25, 1922. In resistance furnaces.

1,481,771. ELECTRICAL FLUSH RECEPTACLE; W. R. Workman, Auburn, N. Y. App. filed Nov. 5, 1921.

1,481,780. ELECTRICAL DISTRIBUTION SYSTEM; G. A. Burnham, Saugus, Mass. App. filed Jan. 2, 1920. Busbar for heavy currents.

(Issued January 29, 1924)

1,481,817. REPEATER FOR MULTIPLEX SYSTEMS; H. A. Affel, Brooklyn, N. Y. App. filed Sept. 26, 1919.

1,481,828. APPARATUS FOR TREATING METALS; R. H. Bulley, Syracuse, N. Y. App. filed April 24, 1916. With an electric arc.

1,481,831. REPEATER ARRANGEMENT FOR MULTIPLEX SIGNALING; C. S. Demarest, Brooklyn, N. Y. App. filed Sept. 13, 1919.

1,481,837. ELECTRIC FURNACE CONTROL APPARATUS; H. C. Hastings and N. Laycock, Rugby, England. App. filed April 19, 1920. For arc furnaces.

1,481,843. ELECTRIC POWER SYSTEM; D. E. Jewitt, Rugby, England. App. filed June 1, 1921. Especially for system of electric ship propulsion.

1,481,848. ELECTRIC POWER SYSTEM; C. MacMillan, Schenectady, N. Y. App. filed March 10, 1923. Especially for systems of electric ship propulsion.

1,481,853. ELECTRIC SHIP PROPULSION; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 16, 1920. Where plurality of propellers is used and one or more motors drive each shaft.

1,481,854. ELECTRICAL CUTTING OF METALS; P. A. E. Armstrong, Loudonville, N. Y. App. filed July 5, 1921.

1,481,869. ELECTRIC HEATER; P. E. Klopsteg, Homewood, and C. S. Hornberger and W. H. Farr, Chicago, Ill. App. filed Nov. 19, 1921. To obtain a rapid concentrated heat.

1,481,876. AUTOTRANSFORMER WITH HEATING COILS; A. Mutscheller and C. Fayer, New York, N. Y. App. filed Oct. 15, 1920. As used in X-ray work.

1,481,880. ELECTRIC SHIP PROPULSION; D. C. Prince, Schenectady, N. Y. App. filed Sept. 9, 1921. For efficient performance of control operations, etc.

1,481,881. ELECTRIC SHIP PROPULSION; D. C. Prince, Schenectady, N. Y. App. filed March 15, 1920. For efficient performance of control operations, etc.

1,481,882. ELECTRIC SHIP PROPULSION; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 16, 1920. To extend to low-speed boats use of driving motors of the synchronous type.

1,481,897. BUZZER; C. I. Hall, Fort Wayne, Ind. App. filed July 6, 1921. Of the alternating-current type with no auxiliary contact devices.

1,481,898. ELECTRIC DRIVE FOR SOUND-REPRODUCING MACHINES; C. I. Hall, Fort Wayne, Ind. App. filed Dec. 23, 1921.

1,481,900. CENTRIFUGALLY ACTUATED SHORT-CIRCUITING DEVICE; N. Hansen, Wilkinsburg, Pa. App. filed June 25, 1919. For dynamo-electric machines.

1,481,904. STATIONARY INDUCTION APPARATUS; A. B. Hendricks, Jr., Pittsfield, Mass. App. filed Aug. 2, 1921. Improved construction and arrangement of parts.

1,481,905. MOTOR-CONTROL SYSTEM; G. W. Huey, Wilkinsburg, Pa. App. filed Oct. 6, 1920. For motors operating under heavy loads.

1,481,907. PROCESS FOR THE OXIDATION OF NITROGEN IN ELECTRIC FURNACES; O. Jensen, Notodden, Norway. App. filed Jan. 10, 1922.

1,481,908. SYSTEM OF CONTROL; H. H. Johnston, Edgewood, Pa. App. filed April 12, 1921. For vehicles equipped with a plurality of driving motors.

1,481,912. JOIST WELDING MACHINES; T. H. Kane, Youngstown, Ohio. App. filed Aug. 15, 1923.

1,481,919. ELECTRIC POWER SYSTEM; T. J. McGill, Chicago, Ill. App. filed May 17, 1920. For controlling small electric generating plants.

1,481,923. METHOD AND APPARATUS FOR LOCATING THE DIRECTION OF A SOURCE OF VIBRATION; G. H. Nash, Highbury, London, England. App. filed Nov. 1, 1918.

1,481,925. LIGHTER; A. Nuhn, Vermilion, Ohio. App. filed March 7, 1923. Attached to steering wheel of automobile.

1,481,938. ELECTRO-RESPONSIVE DEVICE; O. C. Traver, Schenectady, N. Y. App. filed April 12, 1923. To provide improved time limit for relays.

1,481,945. RADIO RECEIVING SYSTEM; J. Weinberger, New York, N. Y. App. filed March 3, 1921. For eliminating interference.

1,481,947. STORAGE BATTERY; W. H. Wood, South Euclid, Ohio. App. filed Nov. 22, 1920. With high capacity per unit of weight and high discharge rate.

1,481,959. RADIO APPARATUS; R. W. French, Chicago, Ill. App. filed March 27, 1922. Improvements to reduce capacity effects.

1,481,969. TELEPHONE-EXCHANGE SYSTEM; F. N. Reeves, Newark, N. J. App. filed Dec. 4, 1919. For machine-switching apparatus.

1,482,047. ELECTRIC FAN; A. Steinbach, Chicago, Ill. App. filed Nov. 3, 1921. Improvements to increase production efficiency, etc.

1,482,080. IGNITION SYSTEM; J. M. Lea, Detroit, Mich. App. filed March 19, 1919. For internal-combustion engines.

1,482,082. SIGNAL BOND; J. Lunde, Crookston, Minn. App. filed Sept. 25, 1922. Signal at central location indicates when track rails or fishplates break.

1,482,083. SERIES PHONE CONNECTOR BLOCK; A. B. McCall, Springfield, Ill. App. filed May 4, 1922. Used in connection with radiophone or telephone reception.

1,482,088. CENTRIFUGE AND MEANS FOR HEATING THE BOWL THEREOF; W. O. Mitscherling, Wilmington, Del. App. filed March 21, 1922.

1,482,098. CIGAR LIGHTER; S. Stocking, Herscher, Ill. App. filed Oct. 19, 1921.

1,482,119. MEANS FOR RECORDING AND REPRODUCING SOUND; L. de Forest, New York, N. Y. App. filed Sept. 18, 1919.

1,482,122. RADIO SYSTEM; W. N. Fanning, Vallejo, Cal. App. filed March 20, 1922. Receiving system controlled from a distant source of radiations.

1,482,142. SEARCHLIGHT AND OTHER PROJECTOR; C. A. Parsons, E. Bennett and H. Rowe, Newcastle-Upon-Tyne, England. App. filed May 10, 1920. With means for dissipating heat.

1,482,192. IGNITION SYSTEM; D. B. Hughes, New York, N. Y. App. filed May 10, 1912. For internal-combustion engines.

1,482,254. ELECTRICAL CONNECTOR; F. D. Pille, Denver, Col. App. filed April 5, 1919. For use between terminals of batteries, etc.

1,482,318. PROTECTIVE DEVICE; F. W. Peek, Jr., Pittsfield, Mass. App. filed May 20, 1918. For protection of electrical conductors from lightning disturbances.